...IONAL MUNICIPALITY OF HAMILTON-WENTWORTH

1988 ENVIRONMENTAL MONITORING

Upper Ottawa Street Landfill Site
Site Monitoring Control

THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

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Upper Ottawa Street Landfill Site
Site Monitoring Control

May 1989
Ref. No. 2184-30

CONESTOGA-ROVERS & ASSOCIATES

CRA
Consulting Engineers

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May 10, 1989 Reference No. 2184-30

Mr. Stan Spencer
Commissioner of Engineering
Regional Municipality of Hamilton-Wentworth
71 Main Street West
Hamilton, Ontario
L8N 3T4

Dear Mr. Spencer:

Re: Final Report - 1988 Environmental Monitoring
Upper Ottawa Street Landfill Site
Site Monitoring Control

The following is our final 1988 monitoring report for the Upper Ottawa Street Landfill Site. The work that was undertaken was in accordance to the terms of reference as outlined by the Regional Municipality of Hamilton-Wentworth (RMHW) in their request for proposal dated May 20, 1987. The work was conducted in two phases. Phase I involved the installation of multilevel monitoring devices; and Phase II involved the execution and overseeing of an environmental monitoring program at the Site.

This report has been finalized from a draft report issued on January 26, 1989 and the amendments primarily reflect the editing of tables in the report for clarification purposes.

Should you have any questions or comments, please do not hesitate to contact our office.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES

Michael G. Mateyk, P. Geol.

CG/JO
Encl.
cc: Mr. Val Terluk, RMHW

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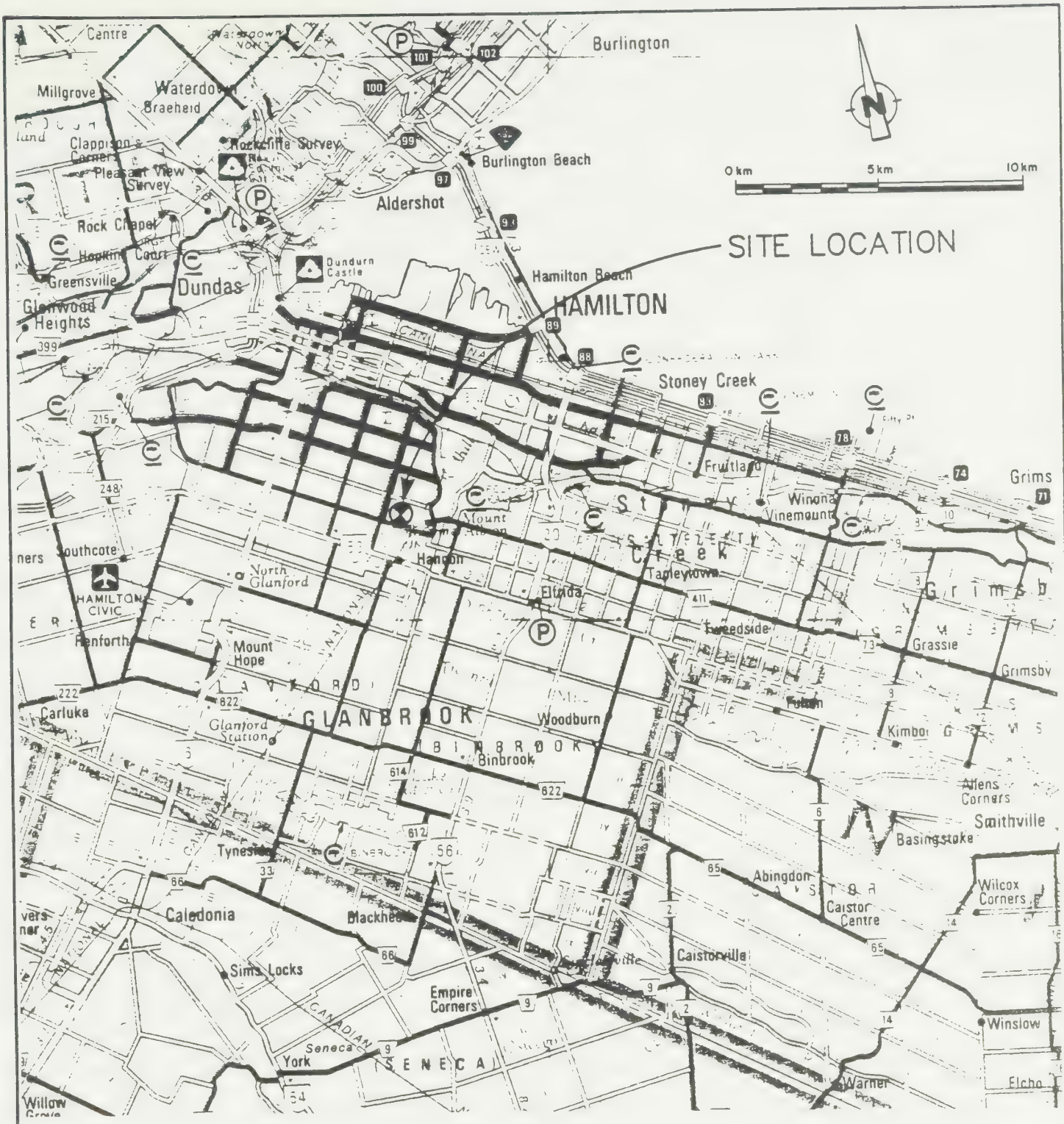
1.0 INTRODUCTION

Conestoga-Rovers & Associates (CRA) was retained by the Regional Municipality of Hamilton-Wentworth (RMHW) to install groundwater monitoring piezometers and execute and conduct an environmental monitoring program at the Upper Ottawa Street Landfill Site (Site). The Site location is presented on Figure 1.1.

The objectives of the Site monitoring control program were outlined by the RMHW in their request for proposal dated May 20, 1987. In order to meet the objectives, the investigation was conducted in two phases. Phase I involved the installation of multilevel monitoring devices at the Site using the guidelines and protocols established by the University of Waterloo Groundwater Institute and requested by the RMHW. Phase I activities are discussed in Section 2.0. The geology of the Site is discussed in Section 4.0.

Phase II involved the execution and overseeing of an environmental monitoring program at the Site. The environmental monitoring program included a Site assessment, leachate monitoring, Red Hill Creek monitoring, and groundwater monitoring. The results of the Site assessment were previously reported in the draft report entitled "Site Assessment of Surface Conditions, Upper Ottawa Street Landfill Site", dated October 23, 1987. Phase II activities undertaken are discussed in Section 3.0. The results of the environmental monitoring program are presented in Section 5.0.



SOURCE: MINISTRY OF TRANSPORTATION,
ONTARIO TRANSPORTATION MAP SERIES,
MAP 5, 1984

figure 1.1

SITE LOCATION
UPPER OTTAWA STREET LANDFILL
Regional Municipality of Hamilton – Wentworth

CRA

2184–30–24/01/89–5–0

2.0 DRILLING AND MONITORING WELL INSTALLATION

Field activities to complete the multilevel piezometer installations commenced on December 1, 1987. The borehole drilling and multilevel piezometer installations were completed by December 16, 1987. Initial well development and testing were completed after installation as permitted by weather conditions. The procedures followed for borehole completion, multilevel installation, and development are presented below.

2.1 BOREHOLE INSTALLATION

All-Terrain Drilling of Waterloo, Ontario were retained to complete the necessary boreholes for the installation of the multilevel piezometers. Drilling commenced on December 2, 1987 and was completed on December 16, 1987.

Boreholes were advanced using a track mounted B-61 drilling machine equipped with 4-1/4 inch (108 mm) internal diameter (I.D.) hollow stem augers. The hollow stem augers were advanced through the overburden to refusal on bedrock. The borehole was advanced up to one metre into the bedrock using air-rotary drilling methods. The drilling rods were removed and threaded steel casing (150 mm) was placed into the borehole. The hollow stem augers were then removed and the annular space was filled with bentonite gravel to provide a seal in order to prevent surface

water or groundwater from the overburden from infiltrating into the corehole.

The boreholes were advanced to the target depth in bedrock using diamond core drilling methods. Compressed air was utilized as a circulating medium to eliminate the need for water supply and reduce the well development requirements. An NX size corehole (76 mm diameter) was created to permit the installation of the multilevel devices. Drilling progress was good. However, the upper rock formations contain chert, resulting in slow drilling and excessive bit wear. Natural gas was observed to emanate from the coreholes but did not impede drilling progress significantly.

All rock core was examined to determine the stratigraphy and identify zones of significant fracturing. Stratigraphic and Instrumentation Logs for each borehole are presented in Appendix A. The stratigraphic information is summarized on Table 2.1. All core is stored in the yard at the Hamilton public works station adjacent to the Site.

2.2 MULTILEVEL PIEZOMETER INSTALLATION

The multilevel piezometers devices were purchased from Solinst Canada (Burlington, Ontario). These devices are based upon the University of Waterloo Groundwater Institute design and provide an inexpensive means of obtaining representative groundwater samples from

TABLE 2.1

SUMMARY OF STRATIGRAPHIC UNITS

STRATIGRAPHIC UNIT	UPPER CONTACT ELEVATIONS (m AMSL) *MP1-87*	*MP2-87*	*MP3-87*	*MP4-87*	UNIT THICKNESSES (m) *MP1-87*	*MP2-87*	*MP3-87*	*MP4-87*
Overburden	187.73	185.12	183.42	187.28	0.76	2.13	2.26	7.38
Lockport Group								
Unnamed Formation	186.97	182.99	181.16	179.90	7.88	4.61	2.88	1.80
Goat Island Formation	179.09	178.38	178.28	178.10	7.46	5.96	5.32	6.45
Gasport Formation								
Upper Member	171.63	172.42	172.96	171.65	1.68	0.96	1.44	1.04
Lower Member	169.95	171.46	171.52	170.61	3.38	3.33	3.45	3.33
Clinton Group								
Decew Formation								
Rochester Formation	166.57	168.13	168.07	167.28	4.00	5.50	5.54	5.14
Ironequoit Formation	162.57	162.63	162.53	162.14	1.83	1.22	1.14	2.00
Reynales Formation								
Upper Member	160.74	161.41	161.39	160.14	2.21	2.47	2.35	2.36
Lower Member	158.53	158.94	159.04	157.78	0.58	0.67	0.72	0.53
							6.20	
Thorold Formation	157.95	158.27	158.32	157.25				
Medina Group								
Grimsby Formation			152.12				3.38	
Cabot Head Formation			148.74					
Bottom of Hole	157.19	154.66	142.11	156.8				

discrete elevations at a single borehole. The multilevel devices were installed on December 10 and 17, 1987. A representative of Solinst Canada supervised the installation to ensure well integrity.

The Solinst system operates by isolating a discrete rock interval between two chemically inflated packers. A sampling port within this interval is connected to ground surface by a 9.5 mm polyethylene tube. The port is constructed of stainless steel, and all riser pipe is PVC. A schematic representation of the multilevel piezometer design is presented on Figure 2.1.

The monitoring intervals in each borehole were determined by the examination of the rock core. The fracture occurrences for each borehole were plotted with respect to depth. These plots are presented in Appendix B. The five most significant fracture zones were selected for monitoring intervals. The multilevel piezometer was designed to provide representative sampling from these intervals.

The multilevel device is assembled as required and installed through the surface casing. All multilevel piezometers were installed as designed and thus permit monitoring of the selected intervals. A lockable cover was threaded onto the well casing to provide protection of the multilevel device. Elevations of the casing were determined to permit the evaluation of the water level data. The completion details for the multilevel piezometers are summarized on Table 2.2.

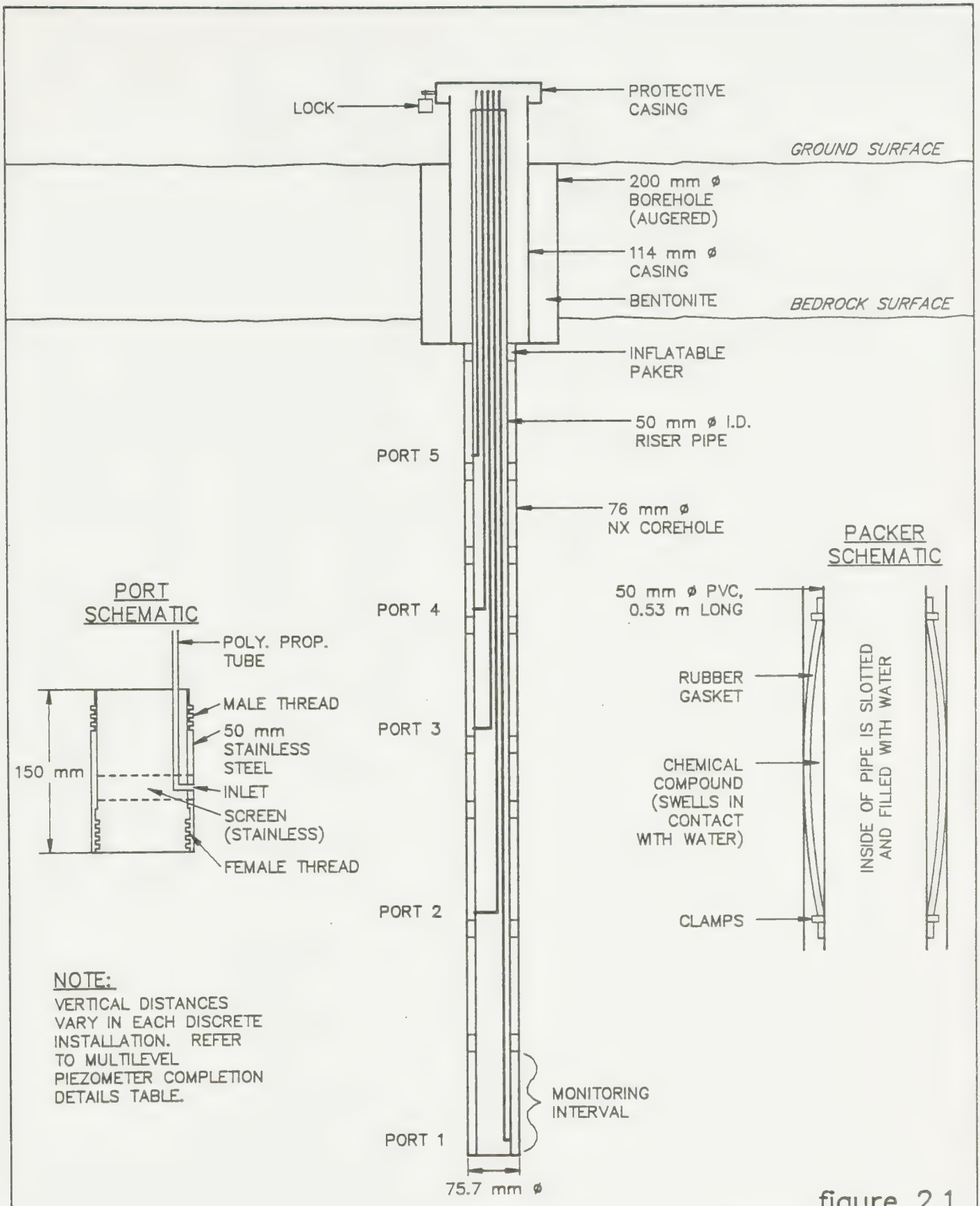


figure 2.1

TYPICAL DRAWING
MULTILEVEL PIEZOMETER INSTALLATION
Regional Municipality of Hamilton – Wentworth

CRA

2184-30-24/01/89-5-0 (D-2)

TABLE 2.2

MULTILEVEL PIEZOMETER COMPLETION DETAILS

BOREHOLE REFERENCE	DATE COMPLETED	GROUND ELEVATION (mAMSL)	REFERENCE ELEVATION (mAMSL)	TOTAL DEPTH (mAMSL)	BOTTOM ELEVATION (mAMSL)	NUMBER	MONITORING INTERVAL DEPTH FROM (mBGS)	DEPTH TO (mBGS)	ELEVATION FROM (mAMSL)	ELEVATION TO (mAMSL)	FORMATIONS MONITORED
MP1-87	04/12/87	187.73	188.64	30.54	157.19	1	27.33	30.48	160.40	157.25	Reynales/Thorald
						2	20.10	23.26	167.63	164.47	Gasport/Rochester
						3	14.4	17.56	173.33	170.17	Goat Island/Gasport
						4	12.24	13.87	175.49	173.86	Goat Island
						5	5.97	9.13	181.76	178.60	Unnamed/Goat Island
MP2-87	08/12/87	185.12	186.09	30.46	154.66	1	25.31	28.47	159.81	156.65	Reynales/Thorald
						2	19.61	22.77	165.51	162.35	Gasport/Rochester
						3	16.35	17.98	168.77	167.14	Goat Island/Gasport
						4	10.65	12.28	174.47	172.84	Goat Island
						5	4.39	7.54	180.73	177.58	Unnamed/Goat Island
MP3-87	11/12/87	183.42	188.42	41.31	142.11	1	38.15	41.30	145.27	142.12	Reynales/Thorald
						2	26.44	29.60	156.98	153.82	Gasport/Rochester
						3	16.22	19.37	167.20	164.05	Goat Island/Gasport
						4	6.04	10.67	177.38	172.75	Goat Island
						5	3.87	5.50	179.55	177.92	Unnamed/Goat Island
MP4-87	16/12/87	187.28	188.01	30.48	156.80	1	27.33	30.48	159.95	156.80	Reynales/Thorald
						2	22.54	25.69	164.74	161.59	Gasport/Rochester
						3	14.75	17.91	172.53	169.37	Goat Island/Gasport
						4	11.09	14.22	176.19	173.06	Goat Island
						5	8.37	10.56	178.91	176.72	Unnamed/Goat Island

2.3 PIEZOMETER DEVELOPMENT

Three standing well volumes were evacuated from each multilevel tube prior to sample collection to ensure that groundwater sampled was representative of the formation conditions. The well development and stabilization records are presented in Appendix C.

The deep sampling tubes were evacuated using the triple tube sampling pump. The pump tubing and packer assembly is inserted to the bottom of the sampling tube. A rubber packer is inflated via an internal nitrogen line to restrict infiltration of formation waters. Compressed nitrogen is then used to force the standing water column to the surface via the pump tubing. Development water is discharged from the pump assembly and may be collected as required for samples. All materials in the triple tube sampling pump consist of teflon or stainless steel. The triple tube sampling pump was flushed with methanol and deionized water prior to use in each sampling tube.

2.4 HYDRAULIC MONITORING

Water level measurements were recorded for each sampling tube to ensure that the devices were functioning as designed and to define the hydrogeologic setting at each piezometer. Water depths are recorded using a narrow diameter electric water level gauge.

The integrity of the multilevel piezometers was determined by removing water from one sampling tube and monitoring the water level in the tube above. The integrity testing has shown that all sampling tubes are functioning properly. However, during the course of the sampling of the piezometers the following conditions were noted:

- flowing conditions were experienced at MP4-2. The piezometer continued to flow for four days subsequent to sampling. The flow from this piezometer was directed to Red Hill Creek;

- the pressurization of MP4-3 resulted in flow from MP4-4 in the course of the June sampling event. No flow was recorded at MP4-3. MP4-4 was sampled with the sampling system inplace at MP4-3. This condition was not experienced during the September sampling event.

In addition water level measurements were recorded prior to each sampling event. This data was used to identify the hydraulic gradients present at each multilevel piezometer and are discussed in Section 4.0.

3.0 1988 MONITORING PROGRAM

The 1988 environmental monitoring program was prepared to 'provide sampling points for chemical analyses that serve to provide an early warning to possible increases in the levels of toxic chemicals' and to monitor the impact of the landfill on the water quality of the Red Hill Creek. The monitoring program consisted of the following components:

1) site assessment;
2) leachate monitoring;
3) Red Hill Creek monitoring; and
4) groundwater monitoring.

The monitoring program conducted in 1988 is presented in Appendix D. A complete list of the parameters analyzed is also presented in Appendix D.

3.1 SITE ASSESSMENT

An initial assessment of the Upper Ottawa Street Landfill Site was conducted in order to determine the existing Site conditions and establish the necessary remedial works required for erosion control and associated Site stabilization. The details and results of the assessment were discussed in CRA, 1987.

3.2 LEACHATE MONITORING

The leachate was sampled twice during 1988 at MH 32 and from two leachate seeps located on the north side of the Site for the parameters identified on Table D.1. Although numerous seeps were observed along the north side of the Site, only the two largest seeps identified in CRA, 1987 were monitored. Erosional rills generally intersect the ground surface along the base of the steep 1:1 side slopes at approximately one metre intervals. The area is sparsely vegetated and is characterized by a septic odour. The leachate sampling locations are presented on Figure 3.1. The results of the leachate monitoring are discussed in Section 5.1.

3.3 RED HILL CREEK MONITORING

The 1988 program provided for surface water quality monitoring at two locations along Red Hill Creek; one upgradient and the other downgradient of the Site. These sampling locations are identified on Figure 3.2. Water samples were collected on two occasions and analyzed for the parameters listed on Table D.2. Sediment samples were collected in June 1988 and analyzed for PCBs and PAHs (Table D.4).

In addition to the surface water samples collected by CRA, the Ministry of the Environment (MOE) collected independent samples in May, 1988, and submitted them for analysis. The results of this monitoring is

figure 3.1

LEACHATE MONITORING LOCATIONS
UPPER OTTAWA STREET LANDFILL
Regional Municipality of Hamilton – Wentworth

CRA

2184-30-24/01/89-5-0

figure 3.2

RED HILL CREEK MONITORING LOCATIONS
UPPER OTTAWA STREET LANDFILL
Regional Municipality of Hamilton – Wentworth

CRA

2184-30-24/01/89-5-0

discussed in conjunction with the surface water samples collected by CRA in Section 5.2.

3.4 GROUNDWATER MONITORING

Groundwater samples were collected twice from each of the four new multilevel piezometers identified in Section 2.0. These locations are presented on Figure 3.3. Groundwater samples collected were analyzed for the parameters on Table D.3.

Prior to sample collection, the depth to water in each piezometer was measured using an electric tape and recorded. The water level measurements are summarized on Table 3.1. In addition, the RFP specified that water level measurements were also to be obtained at locations 15 and 16 once per year. However these observation wells could not be located although a search of the areas proximate to the well locations as identified in Figure 3.3 was conducted.

Groundwater samples were collected from the newly installed piezometers on two occasions. The June sampling was conducted immediately following the development of the piezometers. The development and stabilization records are presented in Appendix C. The subsequent sampling was conducted in September. In the September monitoring event the piezometers were purged of one well volume prior to sampling. However, as a result of the very poor recovery rates for the

figure3.3

GROUNDWATER MONITORING LOCATIONS
UPPER OTTAWA STREET LANDFILL
Regional Municipality of Hamilton — Wentworth

CRA

2184-30-24/01/89-5-0

TABLE 3.1

WATER LEVELS
UPPER OTTAWA LFS MONITORING

Source	*Sampling Interval Elevation (mAMSL)*	*Mid-Screen Elevation (mAMSL)*	*Reference Elevation (mAMSL)*	*Water Depth (m) Jun-88*	*Elevation (mAMSL) Jun-88*	*Water Depth (m) Sep-88*	*Elevation (mAMSL) Sep-88*	*Formation Monitored*
MP1-1	160.40-157.25	158.83	188.64	19.330	169.310	18.480	170.160	Reynales/Thorold
MP1-2	167.63-164.47	166.05		16.705	171.935	16.635	172.005	Gasport/Rochester
MP1-3	173.33-170.17	171.75		5.385	183.255	3.455	185.185	Goat Island/Gasport
MP1-4	175.49-173.86	174.68		7.132	181.508	3.975	184.665	Goat Island
MP1-5	181.76-178.60	180.18		3.374	185.266	3.440	185.200	Unnamed/Goat Island
MP2-1	159.81-156.65	158.23	186.09	11.430	174.660	11.895	174.195	Reynales/Thorold
MP2-2	165.51-162.35	163.93		8.323	177.767	8.560	177.530	Rochester/Irondequoit
MP2-3	168.77-167.14	167.96		8.432	177.658	5.625	180.465	Gasport/Rochester
MP2-4	174.47-172.84	173.66		4.694	181.396	4.080	182.010	Goat Island/Gasport
MP2-5	180.73-177.58	179.16		3.725	182.365	3.920	182.170	Unnamed/Goat Island
MP3-1	145.27-142.12	143.70	184.42	3.587	180.833	3.900	180.520	Cabot Head
MP3-2	156.98-153.82	155.40		10.158	174.262	11.000	173.420	Thorold
MP3-3	167.20-164.05	165.63		5.210	179.210	6.035	178.385	Rochester
MP3-4	177.38-172.75	175.07		2.578	181.842	2.725	181.695	Goat Island/Gasport
MP3-5	179.55-177.92	178.74		2.197	182.223	2.400	182.020	Unnamed/Goat Island
MP4-1	159.95-156.80	158.38	188.01	8.671	179.339	9.410	178.600	Reynales/Thorold
MP4-2	164.74-161.59	163.17		8.770	179.240	9.220	178.790	Rochester/Irondequoit
MP4-3	172.53-169.37	170.95		8.210	179.800	6.735	181.275	Goat Island/Gasport
MP4-4	176.19-173.06	174.63		7.220	180.790	6.730	181.280	Goat Island
MP4-5	178.91-176.72	177.82		7.385	180.625	7.515	180.495	Unnamed

majority of the piezometers a total of three weeks was required per sampling round in order to collect sufficient sample for analysis. The sampling of the piezometers was conducted according to the protocols outlined in Appendix C of the proposal "Environmental Monitoring (Item II), Upper Ottawa Street Landfill Site, Site Monitoring Control", dated June 19, 1987.

The results of the groundwater monitoring are discussed in Section 5.3.

3.5 SUMMARY

Notwithstanding the surface water samples collected in May by the MOE, all analysis was carried out by Novalab from Lachine Quebec. Analytical reports as provided by the laboratories are presented in Appendix E. A summary of the field measurements, sample numbers and locations are presented on Table 3.2 and 3.3. There were no quality assurance/quality control (QA/QC) samples collected as part of the monitoring program.

TABLE 3.2

SAMPLING KEY, JUNE
UPPER OTTAWA LFS MONITORING

CRA Sample Number	*Source*	*Date Sampled (MM/DD/YY)*	*Time (hh:mm)*	*Field pH*	*Field Conductivity*	*BNAE*	*VOC*	*PCB/ PESTICIDES*
1-1	MP1-1	06/09/88	-	ND	ND		X	
		06/20/88		ND	ND	X		
1-2	MP1-2	06/09/88	-	ND	ND		X	
		06/20/88		ND	ND	X		
1-3	MP1-3	06/09/88	-	ND	ND		X	
		06/20/88		ND	ND	X		
1-4	MP1-4	06/09/88	-	ND	ND		X	
		06/23/88		ND	ND	X		
1-5	MP1-5	06/09/88	-	ND	ND		X	
		06/20/88		ND	ND	X		
2-1	MP2-1	06/08/88	-	ND	ND		X	
		06/20/88		ND	ND	X		
2-2	MP2-2	06/08/88	-	ND	ND		X	
		06/20/88		ND	ND	X		
2-3	MP2-3	06/08/88	-	ND	ND		X	
		06/20/88		ND	ND	X		
2-4	MP2-4	06/08/88	-	ND	ND		X	
		06/20/88		ND	ND	X		
2-5	MP2-5	06/08/88	-	ND	ND		X	
		06/23/88		ND	ND	X		

TABLE 3.2

SAMPLING KEY, JUNE
UPPER OTTAWA LFS MONITORING

CRA Sample Number	*Source*	*Date Sampled (MM/DD/YY)*	*Time (hh:mm)*	*Field pH*	*Field Conductivity*	*BNAE*	*VOC*	*PCB/ PESTICIDES*
3-1	MP3-1	06/08/88	-	ND	ND		X	
		06/20/88		ND	ND	X		
3-2	MP3-2	06/09/88	-	ND	ND		X	
		06/20/88		ND	ND	X		
3-3	MP3-3	06/09/88	-	ND	ND		X	
		06/20/88		ND	ND	X		
3-4	MP3-4	06/09/88	-	ND	ND		X	
		06/20/88		ND	ND	X		
3-5	MP3-5	06/09/88	-	ND	ND		X	
		06/20/88		ND	ND	X		
4-1	MP4-1	06/09/88	-	ND	ND		X	
		06/23/88		ND	ND	X		
4-2	MP4-2	06/09/88	-	ND	ND		X	
		06/23/88		ND	ND	X		
4-3	MP4-3*	06/09/88	-	ND	ND		X	
		06/23/88				Not Collected		
4-4	MP4-4	06/09/88	-	ND	ND		X	
		06/23/88		ND	ND	X		
4-5	MP4-5	06/09/88	-	ND	ND		X	
		06/23/88		ND	ND	X		

SAMPLING KEY, JUNE
UPPER OTTAWA LFS MONITORING

CRA Sample Number	*Source*	*Date Sampled (MM/DD/YY)*	*Time (hh:mm)*	*Field pH*	*Field Conductivity*	*BNAE*	*VOC*	*PCB/ PESTICIDES*
Leach MH	Manhole 32	06/08/88	-	ND	ND	X	X	X
SEEP 1	SEEP 1	06/08/88	-	ND	ND	X	X	X
SEEP 2	SEEP 2	06/08/88	-	ND	ND	X	X	X
SP-1	Surface Water Location	06/08/88	-	ND	ND	X	X	X
SP-1	Stream Sediment	06/08/88				X		X
SP-2	Surface Water Location	06/08/88	-	ND	ND	X	X	X
SP-2	Stream Sediment	06/08/88				X		X

ND = Not determined
* Sample could not be collected, no flow

TABLE 3.3

SAMPLING KEY, SEPTEMBER
UPPER OTTAWA LFS MONITORING

CRA Sample Number	*Source*	*Date Sampled (MM/DD/YY)*	*Time (hh:mm)*	*Field pH*	*Field Conductivity*	*BNAE*	*VOC*	*PCB/ PESTICIDES*
1-1	MP1-1	09/23/88	7:30AM	5.63	>20,000	X	X	
1-2	MP1-2	09/23/88	8:45AM	5.80	>20,000	X	X	
1-3	MP1-3	09/23/88	9:50AM	6.14	>20,000	X	X	
1-4	MP1-4	09/15/88	-	6.15	>20,000	X	X	
1-5	MP1-5	09/23/88	11:00AM	6.85	9,000	X	X	
2-1	MP2-1	09/15/88	-	6.03	>20,000	X	X	
2-2	MP2-2	09/15/88	-	6.14	>20,000	X	X	
2-3	MP2-3	09/15/88	-	6.50	>20,000	X	X	
2-4	MP2-4	09/15/88	-	6.76	>20,000	X	X	
2-5	MP2-5	09/15/88	-	7.43	4,470	X	X	
3-1	MP3-1	09/15/88	-	5.75	>20,000	X	X	
3-2	MP3-2	09/15/88	-	5.82	>20,000	X	X	
3-3	MP3-3	09/15/88	-	6.06	>20,000	X	X	
3-4	MP3-4	09/15/88	-	6.44	>20,000	X	X	
3-5	MP3-5	09/15/88	-	7.48	5,120	X	X	
4-1	MP4-1	09/15/88	-	6.21	>20,000	X	X	
4-2	MP4-2	09/23/88	8:15AM	5.98	>20,000	X	X	
4-3	MP4-3	09/15/88	-	6.57	>20,000	X	X	
4-4	MP4-4	09/16/88	-	6.60	>20,000	X	X	
4-5	MP4-5	09/16/88	10:00AM	7.10	8,950	X	X	
Leach MH	Manhole 32	09/16/88	9:25AM	12.45	14,240	X	X	X
SEEP 1	SEEP 1	09/16/88	11:30AM	7.58	11,250	X	X	X
SEEP 2	SEEP 2	09/16/88	12:45PM	7.72	11,700	X	X	X
SP-1	Surface Water Location	09/16/88	1:45PM	7.64	1,226	X	X	X
SP-2	Surface Water Location	09/16/88	1:15PM	7.69	1,548	X	X	X

4.0 GEOLOGIC/HYDROGEOLOGIC EVALUATION

4.1 SITE GEOLOGY

The geology at the Upper Ottawa Street Landfill Site consists of a thin layer of overburden which overlies horizontally bedded, Paleozoic bedrock formations. The overburden consists of a clayey silt. It varies in thickness from 0.76 m at MP1 to 7.38 m at MP4.

The bedrock cores have been described and classified following the nomenclature of Liberty (1971). The lithologic units which were observed in the rock cores include: the Unnamed (or Vinemount), Goat Island and Gasport Formations of the Lockport Group; the Rochester, Irondequoit, Reynales and Thorold Formations of the Clinton Group; and the Grimsby and Cabot Head Formations of the Medina Group. The observed thicknesses of each of these units are presented on Table 2.1. The following section summarizes the lithologic features of the bedrock units.

4.1.1 Lockport Group

Unnamed Formation

This formation is exposed at surface in Red Hill Creek. This unit consists of thinly bedded, greenish-grey, fine-grained, argillaceous

dolomite with shaley partings. The thickness of this unit is greatest near MP1-87 as it has been reduced by erosion at the other locations.

Goat Island Formation

The Goat Island Formation is distinguished by the presence of abundant chert nodules which resulted in slow drilling and excessive bit wear. The unit consists of thin to medium bedded, light grey to cream, hard, very fine grained cherty dolomite. Some fossiliferous beds and layers are present.

Gasport Formation

The Gasport Formation can be divided into two members. The upper member consists of massive bedded, grey, fine to medium grained, porous dolomite. The lower member is composed of massive, greenish-grey fine grained dolomite with some shaley interbeds.

4.1.2 Clinton Group

Rochester Formation

The Rochester Formation is a relatively thick accumulation of thinly bedded, black to grey, fine grained shale. This unit is brittle and breaks easily along the horizontal bedding planes. Areas of intense

fracturing can be determined from the fracture spacings. Thin dolomite and limestone beds, and some bioclastic carbonate beds are observed to interbed with the shale. This unit forms a sharp contact with the underlying Irondequoit Formation. The Decew Formation which commonly caps the Clinton Group was not observed in the rock core.

Irondequoit Formation

The Irondequoit Formation is a distinct, massive bedded, porous, grey medium grained, crystalline limestone. Traces of fossils are present and calcite and silica are observed on fracture faces.

Reynales Formation

Two members are recognized within the Reynales Formation. The Upper Member consists of thin bedded to massive, pale green shaley dolomite with some shaley partings and traces of pyrite nodules. The Lower Member is massive bedded, buff, fine to medium grained fossiliferous dolomite. Pyritic nodules are a distinguishing feature of the Lower Member. Sharp bedding contacts are observed above and below this formation.

Thorold Formation

The Thorold Formation is a distinct unit consisting of thinly bedded, fine grained, green sandstone. Bedding structures can be

observed within the sandstone, and thin grey dolomitic beds and conglomerate beds containing rounded green shale pebbles are common.

4.1.3 Medina Group

Grimsby Formation

The Grimsby Formation generally consists of thinly bedded, reddish-brown, fine grained mudstone, sandstone and shale. The upper contact of this unit is gradational, as interbedding of greenish sandstone is common.

Cabot Head Formation

The Cabot Head Formation was the lowest unit penetrated by the boreholes. This unit consists of grey to greenish, very fine grained, fissile shale. Thin interbedded layers of siltstone and limestone are common.

4.2 SITE HYDROGEOLOGY

The hydrogeologic investigation at the Site is limited to the bedrock. Three hydrogeologic units are evident by the potentiometric elevations as measured at each of the four piezometer nests. These units appear to be loosely related to the three lithologic units identified in

Section 4.1.1 and are referred to as the Lockport Group, the Clinton Group and the Medina Group. The potentiometric elevations are presented on Table 3.1 and illustrated graphically for each nest on Figures 4.1 through 4.4.

The groundwater flow in the Lockport Group displays a moderate vertical gradients of 0.13 directed downwards. A reversal in this gradient was observed in the September monitoring at MP1 and MP4. A lateral component of groundwater flow in this unit is directed to the east southeast at a gradient of 0.003.

The groundwater flow in the Clinton Group at this Site is dominated by the strong vertical gradients of 0.65 directed downward. A lateral component of groundwater flow is directed to the west at a gradient of 0.01.

Hydrogeologic information on the Medina Group is limited since only one piezometer was completed in this unit. A strong upward gradient of 0.58 is observed between the Cabot Head Formation and the Thorold of the Clinton Group at MP3.

Generally, the strongest hydraulic gradients at the Site are directed downwards. It is expected therefore that the bulk of the groundwater infiltrating the Site will migrate downwards. Insufficient data has been obtained in order to determine if there is any seasonal variation in the groundwater elevations.

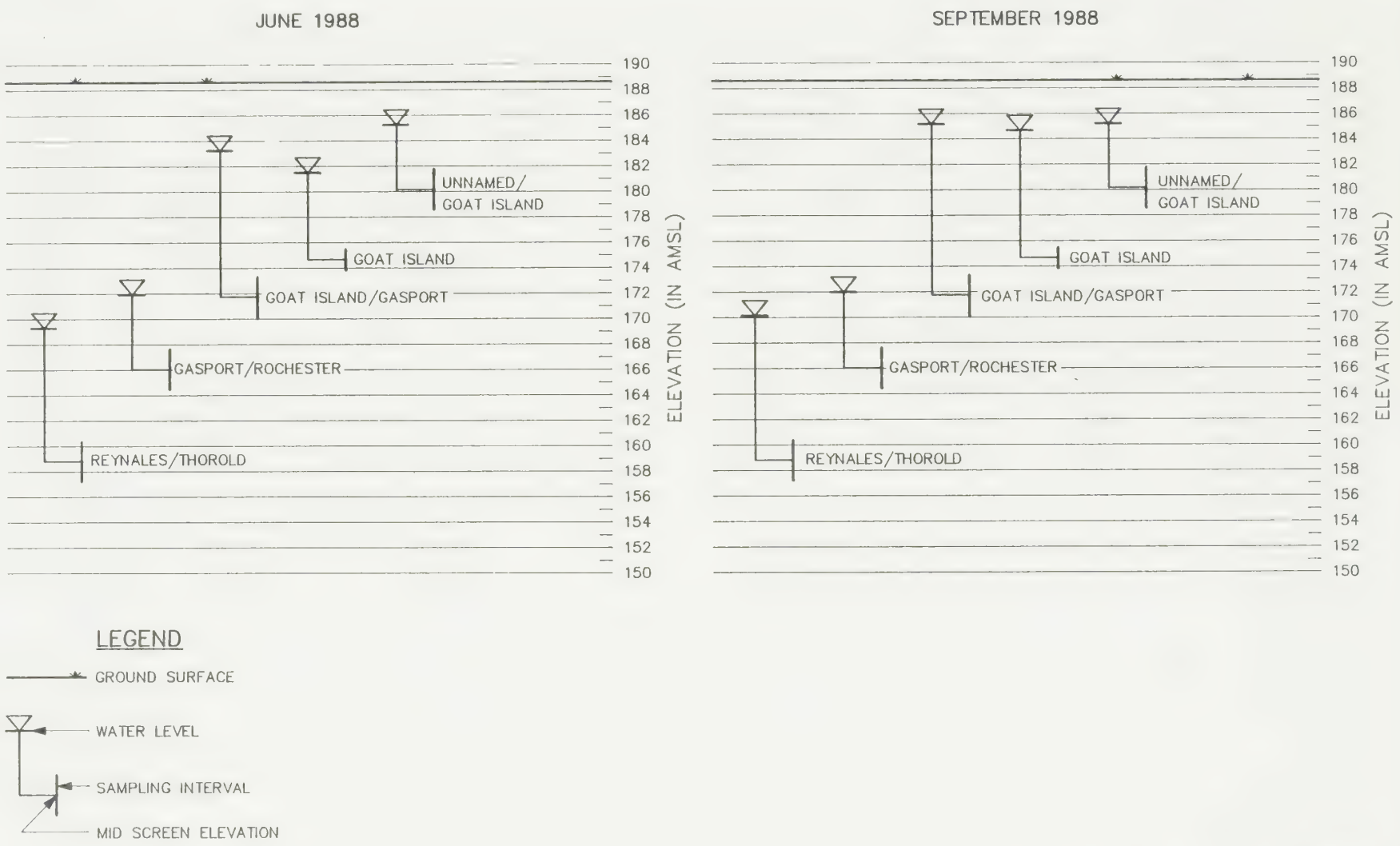


figure 4.1

MP 1 VERTICAL HYDRAULIC GRADIENT
UPPER OTTAWA STREET LANDFILL
Regional Municipality of Hamilton – Wentworth

CRA

2184-30-25/01/89-5-0 (G-1)

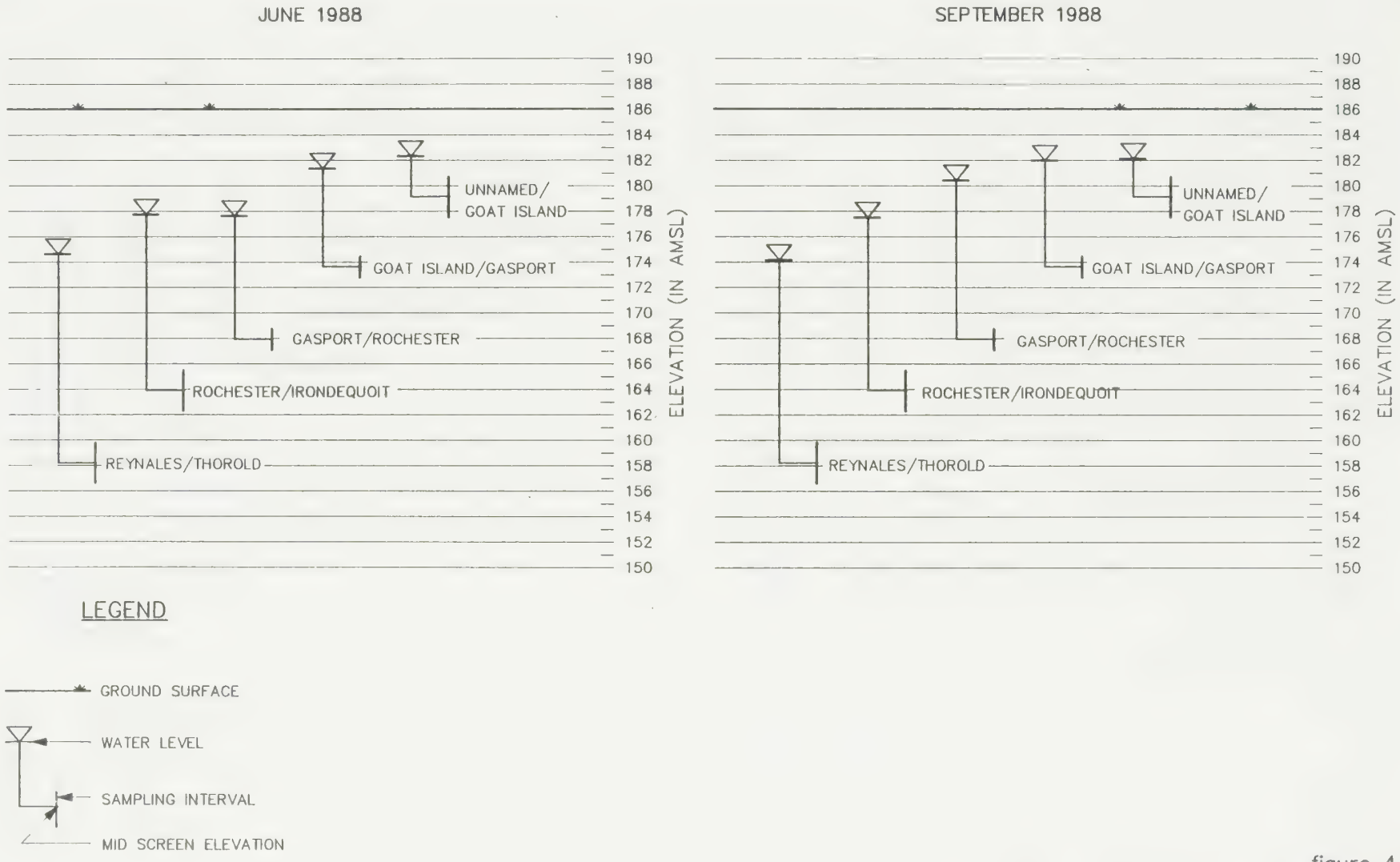


figure 4.2

MP 2 VERTICAL HYDRAULIC GRADIENT
UPPER OTTAWA STREET LANDFILL
Regional Municipality of Hamilton – Wentworth

CRA

2184--30-25/01/89-5-0 (G-2)

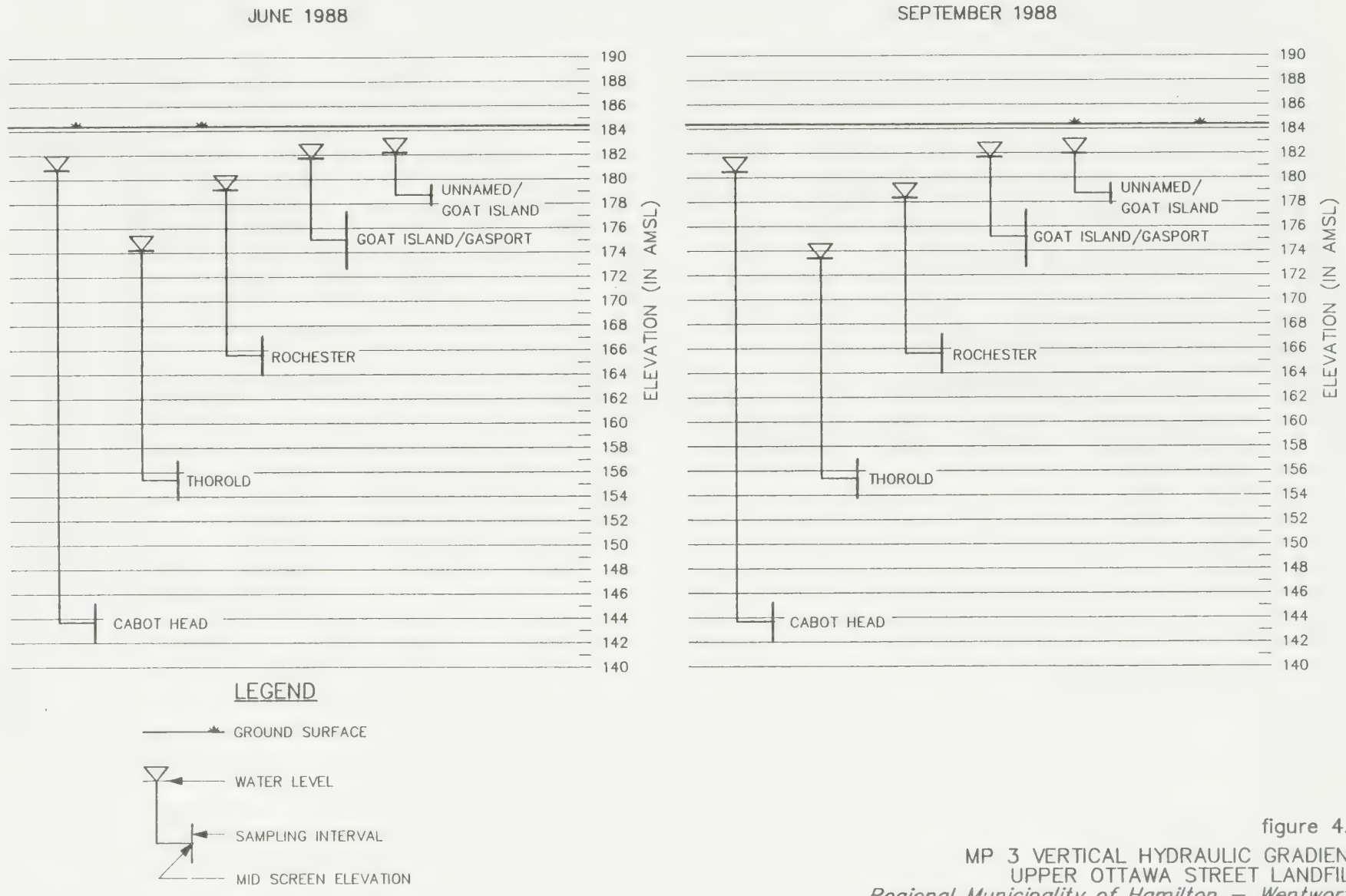


figure 4.3
MP 3 VERTICAL HYDRAULIC GRADIENT
UPPER OTTAWA STREET LANDFILL
Regional Municipality of Hamilton – Wentworth

CRA

2184-30-25/01/89-5-0 (G-3)

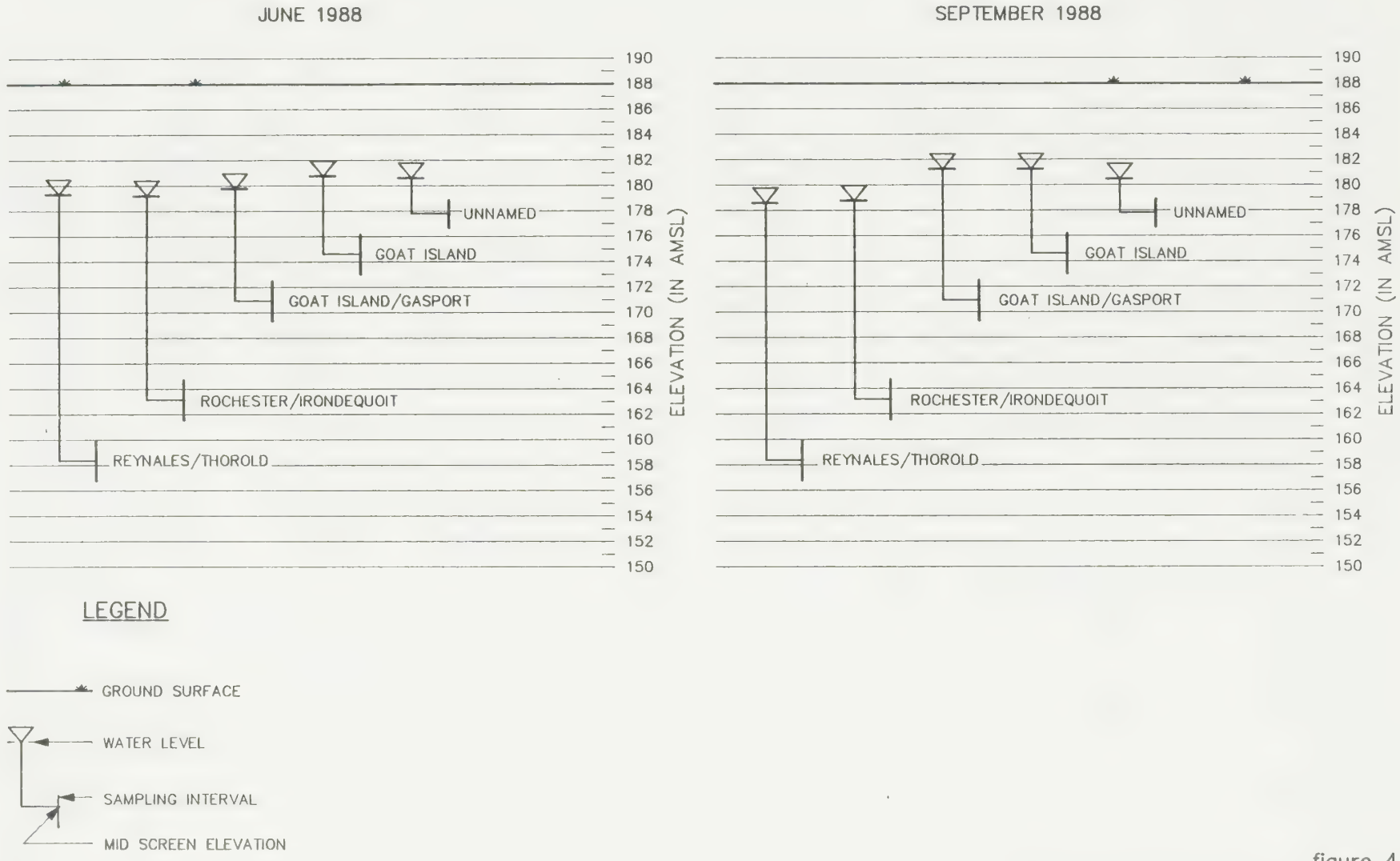


figure 4.4

MP 4 VERTICAL HYDRAULIC GRADIENT
UPPER OTTAWA STREET LANDFILL
Regional Municipality of Hamilton – Wentworth

CRA

2184-30-25/01/89-5-0 (G-3)

5.0 ANALYTICAL RESULTS

5.1 LEACHATE MONITORING

Tables 5.1 and 5.2 summarize the detected occurrences of the leachate monitoring parameters presented in Table D.1. The results of the analyses show the leachate from the manhole is dilute compared to the surface seeps. In the June and September monitoring the relative concentrations for most USEPA Priority Pollutants obtained at each sampling location are similar. However the levels of ethylbenzene, methylstyrene isomers, m+p xylene,and o-xylene were elevated by a factor of 10 in June as compared to the September data obtained for Seep 1. The concentrations of these compounds exceed the respective drinking water criteria, where available, at both Seep 1 and Seep 2. The drinking water criteria are not exceeded in the samples collected at the manhole. The levels of priority pollutants detected are within the levels noted on Table 7 of the RFP for leachate seeps and Table 11 for leachate collected at the manhole at Location 32. Tables 7 and 11 from the RFP are reproduced in Appendix F.

5.2 RED HILL CREEK MONITORING

5.2.1 Surface Water Quality

Surface water samples were collected from the two locations shown on Figure 3.2 in June and September 1988. In addition, the

TABLE 5.1

DETECTED OCCURANCES OF LEACHATE MONITORING PARAMETERS, JUNE 1988
UPPER OTTAWA LANDFILL SITE MONITORING

COMPOUND	*MDL* ($\mu g/L$)	*LAB BLANK* ($\mu g/L$)	*SURFACE SEEP NO 1* ($\mu g/L$)	*SURFACE SEEP NO 2* ($\mu g/L$)	*MANHOLE LOCATION 32* ($\mu g/L$)
VOLATILE ORGANIC COMPOUNDS					
Benzene	1	ND	28	4.7	3.9
Chlorobenzene	1	ND	18	5.9	ND
Chloroform	1	ND	ND	3.5	2.6
1,2-Dichlorobenzene	1	ND	4	2.6	ND
1,3-Dichlorobenzene	1	ND	8.4	ND	ND
1,4-Dichlorobenzene	1	ND	14	5.3	5.9
Dichloromethane	10	ND	20	ND	30[a]
Ethylbenzene	1	ND	120	180	ND
Methylstyrene Isomers	1	ND	250	85	8.3
Mesitylene	1	ND	40	49	3.3
Tetrachloroethylene	1	ND	ND	ND	1.1
Toluene	2	ND	2.9	4.6	ND
M+P Xylene	2	ND	190	390	4.9
O-Xylene	1	ND	100	160	12
Trimethylbenzene Isomers**	1	ND	450	340	17
Tetramethylbenzene Isomers**	1	ND	290	200	11
BASE/NEUTRAL AND ACID COMPOUNDS					
Acenaphthene	2	ND	3.5	ND	ND
Anthacene	2	ND	1	ND	ND
Bis(2-ethylhexyl)phthalate	2	1.7	2	1.8	9.2
Di-n-butyl phthalate	2	12	12	8.3	11
Fluoranthene	2	ND	ND	ND	TR
Fluorene	2	ND	2.9	ND	ND
Naphthalene	2	ND	ND	8	ND
Phenanthene	2	ND	2.9	ND	1.5
2,3,7,8 - TCDD*		0.11	0.12	0.06	0.14
PCB AND ORGANOCHLORINATED PESTICIDES					
Aroclor 1254	0.02	NA	0.81	ND	0.07

* 2,3,7,8-Tetrachlorodibenzo-p-dioxin values are detection limits obtained for individual sample
TR - trace
NA - Not analyzed
ND - Not Detected
[a] Samples analyzed on this date showed higher levels of dichloromethane compared to the other similar samples analysed on separate days.
** Total concentrations were calculated using the response factor of mestylene

TABLE 5.2

DETECTED OCCURANCES OF LEACHATE MONITORING PARAMETERS, SEPTEMBER 1988
UPPER OTTAWA LANDFILL SITE MONITORING

COMPOUND	*MDL* (μg/L)	*BLANK* (μg/L)	*SURFACE SEEP NO 1* (μg/L)	*SURFACE SEEP NO 2* (μg/L)	*MANHOLE LOCATION 32* (μg/L)
VOLATILE ORGANIC COMPOUND					
Benzene	1	ND	2.6	6.5	3
1,2-Dichlorobenzene	1	ND	1.6	ND	TR
1,3-Dichlorobenzene	1	ND	5.7	ND	ND
1,4-Dichlorobenzene	1	ND	9.1	1.8	5.2
A-Methylstyrene	1	ND	ND	ND	1.5
Methylstyrene Isomers	1	ND	ND	ND	19
Mesitylene	1	ND	ND	ND	6
M+P Xylene	2	ND	5.9	17	2.4
O-Xylene	1	ND	16	TR	22
Other Aromatic Compounds	1	ND	560	55	48
BASE/NEUTRAL AND ACID COMPOUNDS					
Acenaphthene	1	ND	4	1.3	2.7
Acenaphthylene	1	ND	ND	ND	1.6
Anthacene	1	ND	TR	ND	
Bis(2-ethylhexyl)phthalate	1	ND	1.6	1.1	2.2
Di-n-butylphthalate	1	ND	ND	2.6	ND
1,3-Dichlorobenzene	1	ND	2.3	ND	ND
1,4-Dichlorobenzene	1	ND	4.9	1.9	3.9
Fluorene	1	ND	3.4	1.7	3.3
N-nitrosodiphenylamine	1	ND	4.1	1.3	4.6
Phenanthene	1	ND	1.9	ND	ND
Phenol	2	ND	ND	ND	3.9
2,4-Dimethylphenol	12	ND	6	7.7	18
Other Dimethylphenols	6	ND	14	ND	66
2,3,7,8 - TCDD*		ND	0.1	0.12	0.16
PCB AND ORGANOCHLORINATED PESTICIDES					
Aroclor 1248	0.05	NA	TR	TR	1.2
Aroclor 1254	0.02	NA	0.03	0.02	0.08
A-BHC	0.001	ND	ND	ND	0.003

* 2,3,7,8-Tetrachlorodibenzo-p-dioxin values are detection limits obtained for individual sample
NA - Not analysed
TR = Trace
ND - Not Detected
Other Aromatic Compounds = Total concentration of tri- and tetramethylbenzene using the response factor of mesitylene

MOE collected two surface water samples in May. These locations are identified as Downstream-SW 2 and Upstream-SW 4, but their geographic proximity to the sampling locations identified in Figure 3.2 has not been determined.

Tables 5.3 and 5.4 summarize the detected occurrences of the surface water monitoring parameters presented in Table D.2. The downstream surface water is characterized by the low level occurrence of bis(2-ethylhexyl)phthalate. The laboratory blank did indicate a similar concentration to those levels detected in June indicating that these levels may not reflect in situ conditions. A review of Table 11 (Appendix F) indicates that bis(2-ethylhexyl)phthalate is commonly detected in the surface water of Red Hill Creek at levels above the drinking water criteria.

Table 5.5 summarizes the detected occurrences of the various compounds analyzed by the MOE. The detection of carboxylic acids in the upstream sample indicates possible biodegradation of organics from landfilled materials. Biodegradation is commonly associated with surface water samples collected downstream of landfill sites. The presence of carboxylic acid in the upstream sample may indicate the presence of a second source influencing the chemistry at this location.

TABLE 5.3

DETECTED OCCURANCES OF BNAEs AND VOCs, SURFACE WATER, JUNE 1988
UPPER OTTAWA LANDFILL SITE MONITORING

COMPOUND	*MDL* ($\mu g/L$)	*LAB BLANK* ($\mu g/L$)	*SURFACE WATER NO 1* ($\mu g/L$)	*SURFACE WATER NO 2* ($\mu g/L$)
VOLATILE ORGANIC COMPOUNDS				
Tetrahydrofuran	5	ND	6.0	7.1
BASE/NEUTRAL AND ACID EXTRACTABLE COMPOUNDS				
Di-n-butyl phthalate	1	1.7	1.7	7.4
Bis(2-ethylhexyl)phthalate	1	12	9.1	17

NOTES:

ND - Not detected.

TABLE 5.4

DETECTED OCCURANCES OF BNAEs AND VOCs, SURFACE WATER,
SEPTEMBER 1988
UPPER OTTAWA LANDFILL SITE MONITORING

COMPOUND	*MDL* ($\mu g/L$)	*LAB BLANK* ($\mu g/L$)	*SURFACE WATER NO 1* ($\mu g/L$)	*SURFACE WATER NO 2* ($\mu g/L$)
VOLATILE ORGANIC COMPOUNDS*				
BASE/NEUTRAL AND ACID EXTRACTABLE COMPOUNDS				
Di-n-butyl phthalate	1	2.3	ND	2.8
Bis(2-ethylhexyl)phthalate	1	1.9	ND	5.7

NOTES:

Surface Water No1 - Upstream
Surface Water No2 - Downstream
* - Volatile organic compounds not detected
ND - Not Detected

TABLE 5.5

DETECTED OCCURRENCE OF COMPOUNDS IN SURFACE WATER
ANALYSIS BY MOE, MAY 1988
UPPER OTTAWA LANDFILL SITE MONITORING

COMPOUND	*MDL (µg/L)*	*LAB BLANK (µg/L)*	*SURFACE WATER NO 2* (µg/L)*	*SURFACE WATER NO 4** (µg/L)*
VOLATILE ORGANIC COMPOUNDS				
Methylene chloride	NA	NA	0.5	0.7
Chloroform	NA	NA	TR	ND
Benzene	NA	NA	TR	TR
Trichloroethylene	NA	NA	ND	0.2
Ethylbenzene	NA	NA	TR	ND
CHLORINATED				
1,2-Dichloroethylene	NA	NA	NP	0.3
Chlorobutene	NA	NA	NP	0.1
Dichlorobenzene	NA	NA	NP	0.1
AROMATIC HYDROCARBONS				
C2 Alkyl Benzene	NA	NA	1.5	NP
C3 Alkyl Benzene	NA	NA	2.9 (3)	NP
C4 Alkyl Benzene	NA	NA	3.3 (11)	NP
C5 Alkyl Benzene	NA	NA	1.2 (7)	NP
Tetralin			0.1	NP
C10H12 Aromatic HC			0.6 (2)	NP
C11H14 Aromatic HC			1.2	NP
Methyl styrene			0.8 (7)	NP
MISCELLANEOUS				
Acetone	NA	NA	0.1	0.1
Dimethyl sulfide	NA	NA	0.1	NP
Propanol	NA	NA	NP	0.1
1,4-Diethylene Dioxide	NA	NA	NP	0.1
Hydrocarbons	NA	NA	0.1	NP
NITROGEN COMPOUNDS				
3-(2-hydroxypropyl)-5-methyl-2-oxazolidone	NA	NA	NP	1.2
N,N-diethyl-3-methyl benzamide	NA	NA	NP	1.2
Benzothiazolone	NA	NA	NP	1.6
CARBOXYLIC ACIDS				
C8 Carboxylic acid	NA	NA	NP	3.2
C9 Carboxylic acid	NA	NA	NP	4
C4 alkyl benzoic acid	NA	NA	NP	0.9
MISCELLANEOUS				
Caffeine	NA	NA	0.6	NP

NOTES:

Number in parentheses - number of compounds
SURFACE WATER NO 2* - Downstream
SURFACE WATER NO 4** - Upstream
NP - Data not provided
ND - Not detected
NA - Not analyzed

5.2.2 Sediment Quality

Sediment samples were collected at upstream and downstream of the Site during the June monitoring event in accordance with the RFP. These samples were submitted for PCB and PAH analyses. The results of the analyses are presented on Table 5.6.

The sediment in Red Hill Creek is characterized by the presence of low level PAHs. The PAH concentrations in the sediment were higher downstream of the landfill as compared to the upstream location. In contrast, the level of PCBs in the sediment were somewhat higher upstream than downstream of the landfill. These observations contrast with previous investigations at the Site.

5.3 GROUNDWATER MONITORING

The four newly installed piezometer nests were sampled in June and September 1988. Groundwater samples collected were analyzed for the parameters on Table D.3. A summary of detected occurrences of VOCs is presented on Tables 5.7 and 5.8. A summary of the detected occurrences of base/neutral acid extractable compounds is presented on Tables 5.9 and 5.10.

Organic compounds in the groundwater, which are found in low concentrations at the MP1, MP2 and MP4 nests, are similar to those detected at locations identified as 'near to the landfill' in Table 17

TABLE 5.7

SUMMARY OF DETECTED OCCURANCES OF VOLATILE COMPOUNDS, GROUNDWATER, JUNE 1988
UPPER OTTAWA LFS MONITORING

Volatile Compounds	*MDL*	*Lab Blank*	*MP1-1*	*MP1-2*	*MP1-3*	*MP1-4*	*MP1-5*	*MP2-1*	*MP2-2*	*MP2-3*	*MP2-4*	*MP2-5*
Benzene	1	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	1.5
Ethylbenzene	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	2	ND	9.1	5.7	12	3.8	ND	2.2	4.2	5.3	ND	2.7
M+P Xylene	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
O-Xylene	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trimethylbenzene Isomers**	1	ND	ND	ND	ND	2.5	1.2	ND	ND	ND	ND	ND
Tetramethylbenzene Isomers**	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichloromethane	10	ND	ND	30*	ND	34*	24*	ND	ND	ND	ND	ND
Tetrahydrofuran	5	ND	6.8	ND	5.3	ND	11	61	48	33	8.7	130
1,4-Dioxane	150	ND	ND	ND	ND	ND	ND	300	310	230	120	1100

Volatile Compounds	*MDL*	*Lab Blank*	*MP3-1*	*MP3-2*	*MP3-3*	*MP3-4*	*MP3-5*	*MP4-1*	*MP4-2*	*MP4-3*	*MP4-4*	*MP4-5*
Benzene	1	ND	6.2	3.1	8.6	5.4	1.2	ND	ND	ND	ND	ND
Ethylbenzene	1	ND	1.2	ND	2.1	1.5	ND	ND	ND	ND	ND	ND
Toluene	2	ND	2.8	4.1	3.2	6.5	2.8	5.4	6.7	11	8.4	ND
M+P Xylene	2	ND	1.3	ND	2.4	1.6	1.9	ND	ND	ND	ND	ND
O-Xylene	1	ND	ND	ND	1.3	ND	1	ND	ND	ND	ND	ND
Trimethylbenzene Isomers**	1	ND	1.2	ND	1.6	ND	4.2	1.4	ND	1.6	ND	ND
Tetramethylbenzene Isomers**	1	ND	ND	ND	ND	ND	1.3	ND	ND	ND	ND	ND
Dichloromethane	10	ND	ND	ND	20*	ND	ND	26*	28*	33*	31*	30*
Tetrahydrofuran	5	ND	160	190	120	60	30	5.9	5.6	ND	ND	7
1,4-Dioxane	150	ND	1400	1200	980	410	280	ND	ND	ND	ND	ND

* Samples ananlysed on this date showed higher levels of dichloromethane compared to the other samples analysed on separate days.
** Total concentrations were calculated using the response factor of mestylene
All values reported as µg/L.
ND - Not detected
TR - Trace

TABLE 5.8

SUMMARY OF DETECTED OCCURANCES OF VOLATILE COMPOUNDS, GROUNDWATER, SEPTEMBER 1988
UPPER OTTAWA LFS MONITORING

Volatile Compounds	*MDL*	*Lab Blank*	*MP1-1*	*MP1-2*	*MP1-3*	*MP1-4*	*MP1-5*	*MP2-1*	*MP2-2*	*MP2-3*	*MP2-4*	*MP2-5*	*MP3-1*
Benzene	2	ND	1.1	ND	ND	ND	ND	1.5	ND	ND	ND	ND	4.8
Toluene	2	ND	5	5.1	11	6	ND	8.6	ND	6.9	8.7	3.5	21
M+P Xylene	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
O-Xylene	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrahydrofuran	5	ND	ND	ND	ND	ND	ND	320	13	9.4	6.6	30	93
1,4-Dioxane	75	ND	ND	ND	ND	ND	ND	TR	87	TR	76	360	900
Dichloromethane	15	ND	ND	ND	ND	ND	ND	23	19	ND	ND	ND	ND
Other Aromatic Compounds	1	ND	ND	1	ND	ND	ND	ND	ND	ND	ND	ND	ND

Volatile Compounds	*MDL*	*MP3-2*	*MP3-3*	*MP3-4*	*MP3-5*	*MP4-1*	*MP4-2*	*MP4-3*	*MP4-4*	*MP4-5*
Benzene	2	2.3	7.4	5.9	3.1	5.5	4.3	ND	ND	ND
Toluene	2	2.8	3	8.1	3.9	11	ND	7.9	22	ND
M+P Xylene	3	ND	TR	2	ND	ND	ND	ND	ND	ND
O-Xylene	1	ND	TR	1	ND	ND	ND	ND	ND	ND
Tetrahydrofuran	5	76	73	16	71	ND	ND	ND	ND	7.5
1,4-Dioxane	75	460	740	130	940	ND	ND	ND	ND	ND
Dichloromethane	15	ND	ND	ND	31	ND	ND	ND	ND	ND
Other Aromatic Compounds	1	ND	1	1.1	ND	ND	ND	ND	ND	ND

NOTES:

Other Aromatic Compounds = Total concentration of tri- and tetramethylbenzene using the response factor of mesitylene
All values reported as µg/L.
ND - Not detected
TR - Trace

TABLE 5.9

SUMMARY OF DETECTED OCCURANCES OF EXTRACTABLE POLLUTANTS, GROUNDWATER, JUNE 1988
UPPER OTTAWA LFS MONITORING

Compounds	*MDL*	*MP1-1*	*MP1-2*	*MDL*	*MP1-3*	*MDL*	*MP1-4*	*MP1-5*	*MP2-1*	*MP2-2*	*MP2-3*	*MP2-4*	*MP2-5*
Di-n-butyl phthalate	1	7.6	12	1	7.5	1	6.8	4.4	6.1	180	280	350	190
Bis(2-ethylhexyl)phthalate	1	3.2	3.3	1	2.7	1	1.1	1.6	2.2	2.6	2.1	2	1.3
Aniline	4	ND	ND	10	ND	4	TR	ND	4	7.9	19	6.6	ND
Phenol	1	ND	ND	10	ND	1	ND	ND	ND	ND	1.2	ND	ND
O-Cresol	2	ND	ND	5	ND	2	ND	ND	ND	ND	21	7.5	ND
M+P Cresol	2	ND	ND	5	8.4	2	ND	ND	ND	ND	3.5	2.9	ND
Xylenols	6	ND	ND	50	ND	6	ND	ND	ND	ND	ND	ND	180
Benzothiazole	2	4.8	49	5	79	2	160	3.1	150	15	78	18	7.4

Compounds	*MDL*	*MP3-1*	*MDL*	*MP3-2*	*MP3-3*	*MP3-4*	*MP3-5*	*MDL*	*MP4-1*	*MDL*	*MP4-2*	*MP4-3**	*MP4-4*
Di-n-butyl phthalate	50	250	1	470	4.6	6.4	3.7	5	110	1	180	No Data	240
Bis(2-ethylhexyl)phthalate	50	ND	1	2.6	2	2.1	5.4	5	7.8	1	5.1	No Data	4.3
Aniline	4	ND	4	ND	ND	5.9	ND	20	ND	4	13	No Data	12
Phenol	2	ND	1	ND	ND	ND	ND	5	ND	1	ND	No Data	ND
O-Cresol	5	ND	2	ND	ND	ND	ND	5	ND	2	ND	No Data	ND
M+P Cresol	5	ND	2	ND	ND	ND	ND	5	ND	2	ND	No Data	ND
Xylenols	15	ND	6	ND	ND	ND	ND	10	ND	6	ND	No Data	ND
Benzothiazole	5	15	2	92	2.6	4.7	6.7	2	6	2	26	No Data	34

Compounds	*MDL*	*MP4-5*	*LAB BLANK #1*	*LAB BLANK #2*
Di-n-butyl phthalate	1	170	5.5	120
Bis(2-ethylhexyl)phthalate	1	9.6	1.1	6.2
Aniline	4	ND	ND	ND
Phenol	1	ND	ND	ND
O-Cresol	2	ND	ND	ND
M+P Cresol	2	ND	ND	ND
Xylenols	6	ND	ND	ND
Benzothiazole	2	4.7	ND	ND

NOTES:

All values reported as µg/L.
TR - Trace
ND - Not detected
* - Sample not collected, see Table 3.2

TABLE 5.10

SUMMARY OF DETECTED OCCURANCES OF EXTRACTABLE POLLUTANTS, GROUNDWATER, SEPTEMBER 1988
UPPER OTTAWA LFS MONITORING

Compounds	*MDL*	*LAB BLANK*	*MP1-1*	*MP1-2*	*MP1-3*	*MP1-4*	*MP1-5*	*MP2-1*	*MP2-2*	*MP2-3*	*MP2-4**	*MP2-5*
M+P Cresol	1	ND	ND	ND	ND	1.6	ND	ND	ND	ND	No Data	ND
Dimethylphenols	6	ND	ND	ND	ND	ND	ND	ND	ND	ND	No Data	26
Benzothiazole	1	ND	28	76	99	62	7.5	240	33	16	No Data	ND
Bis(2-ethylhexyl)phthalate	1	1.9	1.6	2.6	ND	2.2	ND	1.9	2	2.1	No Data	ND
Di-n-butyl phthalate	1	2.3	12	1.5	ND	17	14	4.8	8.4	9.4	No Data	4
Aniline	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	No Data	ND

Compounds	*MDL*	*MP3-1*	*MP3-2*	*MP3-3*	*MP3-4*	*MP3-5*	*MP4-1*	*MP4-2*	*MP4-3*	*MP4-4*	*MP4-5*
M+P Cresol	1	ND	ND	8.8	ND	ND	ND	ND	ND	ND	ND
Dimethylphenols	6	ND	12	ND	ND	ND	ND	ND	ND	ND	ND
Benzothiazole	1	32	10	1.4	3.5	9.1	11	ND	2.4	8.2	ND
Bis(2-ethylhexyl)phthalate	1	ND	2.5	2.6	1.5	1.4	1.4	ND	1.2	1.3	ND
Di-n-butyl phthalate	1	2.7	3.1	5.1	16	3.9	30	ND	12	35	ND
Aniline	1	ND	ND	ND	ND	ND	ND	ND	10	4.1	ND

NOTES:

All values reported as µg/L.
ND - not detected
* - insufficient sample collected for analysis

(Appendix F). The organics in the groundwater include benzene, toluene, phthalates, tetrahydrofuran and 1,4-dioxane. The organics in greatest numbers and highest concentration were detected in groundwater sample collected at the MP3 nest. The levels of the organics in the groundwaters from this nest reflected the leachate collected at Seeps 1 and 2 (Tables 5.1 and 5.2). The highest levels of 1,4-dioxane and tetrahydrofuran were detected at the MP3 nest in both the June and September monitoring events.

5.4 SUMMARY

Table 5.11 summarizes the drinking water criteria set forth by the MOE and New York State for select organic compounds.

The leachate collected from surface seeps located along the north face of the Site display elevated levels of organic compounds when compared to the leachate collected at the manhole at Location 32. The concentrations of compounds detected in the seeps exceed the drinking water criteria, where available. The drinking water criteria are not exceeded in the samples collected at the manhole.

The surface water of Red Hill Creek downstream of the Site is characterized by the low level occurrence of bis(2-ethylhexyl)phthalate. There are fewer detectable organic compounds in Red Hill Creek than in the leachate. The impact of the landfill on the Creek appears to be minimal as the

TABLE 5.11

DRINKING WATER CRITERIA
UPPER OTTAWA STREET LANDFILL SITE

COMPOUND	*DRINKING WATER CRITERIA[f,g] (ppb)*
Benzene	1.0[g]
Toluene	50.0[g]
Xylenes	50.0[g]
Ethylbenzene	50.0[g]
C_3-benzenes	50.0[g]
C_4-benzenes	-
Dichloromethane	50.0[g]
Dichlorobenzenes	20.0[g]
di-n-butyl phthalate	50.0[g]
bis(2-ethylhexyl)phthalate	4.0[g]
Phenol	2.0[f]
Cresols	2.0[f]
Xylenols	2.0[f]
Aniline	1.0[f]
Tetrahydrofuran	50.0[g]
1,4-dioxane	-
Benzothiazole	-

f Ontario Ministry of the Environment Drinking Water Objectives (where available).

g New York State Proposed Drinking Water Toxic Standards, January 1985 (where available).

levels of the organic compounds detected downstream are not significantly different than the levels detected upstream.

The sediment in Red Hill Creek is characterized by the presence of low level PAHs. The PAH concentrations in the sediment were higher downstream of the landfill as compared to the upstream location. In contrast, the level of PCBs in the sediment were somewhat higher upstream than downstream of the landfill.

The groundwater collected from the MP1, MP2 and MP4 nests are characterized by low levels of organic compounds. The concentrations at these locations do not exceed the drinking water criteria where available. However, the groundwater quality of samples collected from the MP3 nest reflected the levels observed at the leachate seeps located along the north face of the Site. The levels of tetrahydrofuran were 10 times higher at the MP3 nest as compared to the other installations; the level of 1,4-dioxane was 100 times higher. There are no drinking water criteria for these two compounds.

6.0 CONCLUSIONS

Based on the available data it is concluded that:

1) The geology of the area consists of a thin layer of overburden which overlies horizontally bedded Paleozoic bedrock formations.

2) The hydrogeologic investigation at the Site is limited to the bedrock formations. The strongest hydraulic gradients at the Site are directed downwards. It is expected therefore that the bulk of the groundwater infiltrating the Site will migrate downwards.

3) The results of the organic analyses of the leachate samples shows that the leachate from the manhole (Location 32) is relatively dilute compared to the surface seeps located along the northern face of the landfill. The concentrations of compounds detected in the seeps exceed the drinking water criteria, where available. The drinking water criteria are not exceeded in the samples collected at the manhole.

4) The impact of the landfill on Red Hill Creek appears to be minimal because the levels of the organic compounds detected downstream are not significantly different than the levels detected upstream.

5) The sediment in Red Hill Creek is characterized by the presence of low level PAHs. The PAH concentrations in the sediment were higher downstream of the landfill as compared to the upstream location. In

contrast, the level of PCBs in the sediment were somewhat higher upstream than downstream of the landfill.

6) The groundwater collected from the MP1, MP2 and MP4 nests are characterized by low levels of organic compounds. The concentrations at these locations do not exceed the drinking water criteria where available.

7) The groundwater quality of samples collected from the MP3 nest reflected the levels observed at the leachate seeps located along the north face of the Site. The levels of tetrahydrofuran were 10 times higher at the MP3 nest as compared to the other installations; the level of 1,4-dioxane was 100 times higher. There are no drinking water criteria for these two compounds.

All of Which is Respectfully Submitted,

CONESTOGA-ROVERS & ASSOCIATES

Christine H. Galinski, M. Sc.

Michael G. Mateyk, P.Geol.

APPENDIX A

STRATIGRAPHIC AND INSTRUMENTATION LOGS

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

PROJECT NAME: UPPER OTTAWA STREET LANDFILL
HOLE DESIGNATION: MW1–87

PROJECT NO.: 2184–10
DATE COMPLETED: 4/12/87
CLIENT: REGIONAL MUNICIPALITY OF HAMILTON WENTWORTH
DRILLING METHOD: AIR CORE
LOCATION: 70 m WEST OF UW9
CRA SUPERVISOR: L. LEMON

DEPTH m BG	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
m BG	REFERENCE ELEVATION	m AMSL			%	%	%
0.0	GROUND ELEVATION	188.64 / 187.73	LOCKING PROTECTIVE CASING				
	CLAYEY SILT: brown, wet	186.97	200 mm ø BOREHOLE	0	0		
	DOLOMITE (UNNAMED FORMATION, LOCKPORT GROUP): fine grained, thinly bedded, argillaceous, some shaley partings, greenish gray, uneven bedding planes, fossiliferous, regular fracturing		114 mm ø CASING; BENTONITE SEAL	1	97	88	+100
4.0				2	99	27	+100
6.0			INFLATABLE PAKER	3	100	82	+100
8.0			50 mm ø RISER PIPE				
	DOLOMITE (GOAT ISLAND FORMATION, LOCKPORT GROUP): very fine grained, thin to medium bedded, cherty, light gray to cream, very hard, some fossiliferous beds – numerous chert nodules between 9.7 and 15.2 m. BGS	179.09		4	99	70	+100
10.0			76 mm ø NX COREHOLE				
12.0				5	100	50	+100
14.0							
16.0				6	100	61	+100
	DOLOMITE (UPPER MEMBER, GASPORT FORMATION, LOCKPORT GROUP): massive, gray, fine to medium grained, porous	171.63					
18.0	DOLOMITE (LOWER MEMBER, GASPORT FORMATION, LOCKPORT GROUP): massive, fine grained, greenish gray, some shaley beds, irregular bedding	169.95		7	100	85	+100
20.0							
	SHALE (ROCHESTER FORMATION, CLINTON GROUP): black to gray, fine grained, brittle, thinly bedded, close fractures, interbedded with thin bioclastic dolomite and limestone beds, fossiliferous	166.57		8	99	66	+100
22.0							
24.0	LIMESTONE (IRONDEQUOIT FORMATION, CLINTON GROUP): massive, gray, medium grained, crystalline, porous, trace fossils, trace calcite, and silica on fractures	162.57		9	83	53	+100

NOTES:

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

PROJECT NAME: UPPER OTTAWA STREET LANDFILL
HOLE DESIGNATION: MW1–87

PROJECT NO.: 2184–10
DATE COMPLETED: 4/12/87
CLIENT: REGIONAL MUNICIPALITY OF HAMILTON WENTWORTH
DRILLING METHOD: AIR CORE
LOCATION: 70 m WEST OF UW9
CRA SUPERVISOR: L. LEMON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
m BG		m AMSL			%	%	%
24.0							
	LIMESTONE (IRONDEQUOIT FORMATION, CLINTON GROUP): massive, gray, medium grained, crystalline, porous, trace fossils, trace calcite, and silica on fractures	*160.74*	50 mm ϕ RISER PIPE	9	83	53	+100
26.0	SHALEY DOLOMITE (UPPER MEMBER, REYNALES FORMATION, CLINTON GROUP): very fine grained, thinly bedded to massive, pale green, shaley partings, trace pyrite nodules	*158.53*	INFLATABLE PAKER	10	100	91	+100
28.0	DOLOMITE (LOWER MEMBER, REYNALES FORMATION, CLINTON GROUP): massive bedded, fine to medium grained, buff, fossiliferous, pyrite nodules, sharp bedding contacts	*157.95*	76 mm ϕ NX COREHOLE	11	87	65	+100
30.0	SANDSTONE (THOROLD FORMATION, CLINTON GROUP): thinly bedded, fine grained, green, trace shaley laminae, thin dolomitic or conglomerate beds – dolomitic beds at 30.13 to 30,25 m. – conglomerate beds at 30.5, 30.58, 30.69, 30.84 m.	*157.19*					
32.0	END OF HOLE AT 30.54 m BGS						
34.0	NOTES: 1. Fracture occurrences and core breaks are detailed on separate forms.						
36.0	2. Core from Run 6 was dropped on						
38.0							
40.0							
42.0							
44.0							
46.0							
48.0							

NOTES:

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

PROJECT NAME: UPPER OTTAWA STREET LANDFILL
HOLE DESIGNATION: OW2–87

PROJECT NO.: 2184–10
DATE COMPLETED: 8/12/87
CLIENT: REGIONAL MUNICIPALITY OF HAMILTON WENTWORTH
DRILLING METHOD: AIR CORE
LOCATION: EAST OF UW7
CRA SUPERVISOR: L. LEMON

DEPTH m BG	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
m BG	REFERENCE ELEVATION	m AMSL			%	%	%
0.0	GROUND ELEVATION	186.09 / 185.12	LOCKING PROTECTIVE CASING				
	CLAYEY SILT: brown, wet		200 mm ø BOREHOLE	0	0		
2.0		182.99	114 mm ø CASING; BENTONITE SEAL				
	DOLOMITE (UNNAMED MEMBER, LOCKPORT FORMATION): fine grained, thinly bedded, argillaceous, some shaley partings, greenish gray, uneven bedding planes, fossiliferous, regular fracturing			1	94	70	+100
4.0			INFLATABLE PAKER	2	94	83	
6.0			50 mm ø RISER PIPE	3	100	77	
	DOLOMITE (GOAT ISLAND MEMBER, LOCKPORT FORMATION): very fine grained, thin to medium bedded, cherty, light gray to cream, very hard, abundant chert nodules, some fossiliferous beds	178.38					
8.0	Chert nodules at:			4	100	46	
10.0			76 mm ø NX COREHOLE				
12.0				5	100	53	
	DOLOMITE (GASPORT MEMBER, LOCKPORT FORMATION): massive, gray, fine to medium grained, porous	172.42 / 171.46					
14.0							
	DOLOMITE (DECEW FORMATION): massive, fine grained, greenish gray, some shaley beds, irregular bedding			6	100	100	
16.0		168.01					
	SHALE (ROCHESTER FORMATION): black to gray, fine grained, brittle, thinly bedded, close fractures, interbedded with thin bioclastic dolomite and limestone beds, fossiliferous			7	100	75	
18.0							
20.0							
	LIMESTONE (IRONDEQUOIT FORMATION): massive, gray, medium grained, crystalline, porous, trace fossils, trace calcite, and silica on fractures			8	100	60	
22.0		162.63					
	SHALEY DOLOMITE (REYNALES FORMATION, UPPER MEMBER): very fine grained, thinly bedded to massive, pale green, shaley partings, trace pyrite nodules	161.28		9	100	91	
24.0							

NOTES:

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

PROJECT NAME: UPPER OTTAWA STREET LANDFILL
HOLE DESIGNATION: OW2-87 (PAGE 2 of 2)
PROJECT NO.: 2184-10
DATE COMPLETED: 8/12/87
CLIENT: REGIONAL MUNICIPALITY OF HAMILTON WENTWORTH
DRILLING METHOD: AIR CORE
LOCATION: EAST OF UW7
CRA SUPERVISOR: L. LEMON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
m BG		m AMSL			%	%	%
24.0							
	SHALEY DOLOMITE (REYNALES FORMATION, UPPER MEMBER): very fine grained, thinly bedded to massive, pale green, shaley partings, trace pyrite nodules		50 mm ø RISER PIPE	9	100	91	
26.0		158.94					
	DOLOMITE (REYNALES FORMATION, LOWER MEMBER): massive bedded, fine to medium grained, buff, fossiliferous, pyrite nodules, sharp bedding contacts	158.27	76 mm ø NX COREHOLE	10	100	87	
28.0			INFLATABLE PAKER				
	SANDSTONE (THOROLD FORMATION) thinly bedded, fine grained, green, trace shaley laminae, thin dolomitic or conglomerate beds			11	100	82	
30.0		154.66					
	END OF HOLE AT 30.46 m BGS						
32.0	NOTES: 1. Fracture occurrences and core breaks are detailed on separate forms.						
34.0	2. Core from Run 6 was dropped on removal from core tube and may not have been reassembled accurately.						
	3.						
36.0							
38.0							
40.0							
42.0							
44.0							
46.0							
48.0							

NOTES:

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

PROJECT NAME: UPPER OTTAWA STREET LANDFILL
HOLE DESIGNATION: OW3-87

PROJECT NO.: 2184-10
DATE COMPLETED: 11/12/87
CLIENT: REGIONAL MUNICIPALITY OF HAMILTON WENTWORTH
DRILLING METHOD: AIR CORE
LOCATION: NEAR UW22
CRA SUPERVISOR: L. LEMON

DEPTH m BG	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
m BG	REFERENCE ELEVATION	m AMSL			%	%	%
0.0	GROUND ELEVATION	184.42 183.42	LOCKING PROTECTIVE CASING				
	CLAYEY SILT: brown, wet		200 mm ø BOREHOLE	0	0		
		182.52	114 mm ø CASING				
	DOLOMITE (UNNAMED MEMBER, LOCKPORT FORMATION): fine grained, thinly bedded, argillaceous, some shaley partings, greenish gray, uneven bedding planes, fossiliferous, regular fracturing		BENTONITE SEAL				
2.0		181.15		1	100	85	
4.0	DOLOMITE (GOAT ISLAND MEMBER, LOCKPORT FORMATION): very fine grained, thin to medium bedded, cherty, light gray to cream, very hard, abundant chert nodules, some fossiliferous beds		INFLATABLE PAKER	2	99	45	+100
6.0	Chert nodules at:		50 mm ø RISER PIPE	3	100	38	
8.0				4	95	80	
10.0			76 mm ø NX COREHOLE	5	100	80	
		172.96					
	DOLOMITE (GASPORT MEMBER, LOCKPORT FORMATION): massive, gray, fine to medium grained, porous			6	100	92	
12.0		171.52					
	DOLOMITE (DECEW FORMATION): massive, fine grained, greenish gray, some shaley beds, irregular bedding			7	97	93	
14.0							
	SHALE (ROCHESTER FORMATION): black to gray, fine grained, brittle, thinly bedded, close fractures, interbedded with thin bioclastic dolomite and limestone beds, fossiliferous	168.07		8	99	80	
16.0							
18.0	LIMESTONE (IRONDEQUOIT FORMATION): massive, gray, medium grained, crystalline, porous, trace fossils, trace calcite, and silica on fractures			9	100	71	
20.0	SHALEY DOLOMITE (REYNALES FORMATION, UPPER MEMBER): very fine grained, thinly bedded to massive, pale green, shaley partings, trace pyrite nodules	162.53		10	100	90	
22.0	DOLOMITE (REYNALES FORMATION, LOWER MEMBER): massive bedded, fine to medium grained, buff, fossiliferous, pyrite nodules, sharp bedding contracts	161.39					
24.0	SANDSTONE (THOROLD FORMATION): thinly bedded, fine grained, green, trace shaley laminae, thin dolomitic or conglomerate beds	159.04 158.32		11	99	64	

NOTES:

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

PROJECT NAME: UPPER OTTAWA STREET LANDFILL
PROJECT NO.: 2184–10
CLIENT: REGIONAL MUNICIPALITY OF HAMILTON WENTWORTH
LOCATION: NEAR UW22

HOLE DESIGNATION: OW3–87

DATE COMPLETED: 11/12/87
DRILLING METHOD: AIR CORE
CRA SUPERVISOR: L. LEMON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
m BG		m AMSL			%	%	%
24.0							
	DOLOMITE (REYNALES FORMATION, LOWER MEMBER): massive bedded, fine to medium grained, buff, fossiliferous, pyrite nodules, sharp bedding contacts	159.04 158.32		11	99	64	
26.0			INFLATABLE PAKER				
	SANDSTONE (THOROLD FORMATION): thinly bedded, fine grained, green, trace shaley laminae, thin dolomitic or conglomerate beds			12	100	73	
28.0							
30.0							
			50 mm ø RISER PIPE	13	98	81	
32.0	MUDSTONE (GRIMSBY FORMATION): thinly bedded, very fine grained, reddish brown, interbedded mudstone, sandstone, and shale, trace fossils – thin green shale bed at 32.67 m. – fossiliferous bed from 32.54 – 32.67 m. – interbedded red and green siltstone from 34.44 – 34.68 m.	152.12					
34.0			76 mm ø NX COREHOLE	14	100	61	
		148.74					
36.0	SHALE (CABOT HEAD FORMATION): very fine grained, gray to greenish, fissile, some interbeds of limestone, and siltstone – limestone or siltstone beds from: 36 – 36.09 m., 37 – 37.28 m., 38.06 – 38.11 m., 38.51 – 38.7 m., 38.9 – 39 m., 39.17 – 39.2 m., 39.49 – 39.6 m.			15	100	80	
38.0							
40.0				16	98	61	
		142.11					
42.0	END OF HOLE AT 41.31 m BGS NOTES: 1. Fracture occurrences and core breaks are detailed on separate forms.						
44.0							
46.0							
48.0							

NOTES:

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

PROJECT NAME: UPPER OTTAWA STREET LANDFILL
HOLE DESIGNATION: OW4–87

PROJECT NO.: 2184–10
DATE COMPLETED: 16/12/87
CLIENT: REGIONAL MUNICIPALITY OF HAMILTON WENTWORTH
DRILLING METHOD: AIR CORE
LOCATION: 30 m SOUTH OF UW12
CRA SUPERVISOR: L. LEMON

DEPTH m BG	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
m BG	REFERENCE ELEVATION	m AMSL	LOCKING PROTECTIVE CASING		%	%	%
0.0	GROUND ELEVATION	*188.01* *187.28*					
	CLAYEY SILT: brown, wet	*187.28*	200 mm ø BOREHOLE	0	0		
2.0			114 mm ø CASING				
4.0			BENTONITE SEAL				
6.0			INFLATABLE PAKER				
		179.90					
8.0	DOLOMITE (UNNAMED MEMBER, LOCKPORT FORMATION): fine grained, thinly bedded, argillaceous, some shaley partings, greenish gray, uneven bedding planes, fossiliferous, regular fracturing		50 mm ø RISER PIPE	1	98	48	+100
		178.10					
10.0	DOLOMITE (GOAT ISLAND MEMBER, LOCKPORT FORMATION): very fine grained, thin to medium bedded, cherty, light gray to cream, very hard, abundant chert nodules, some fossiliferous beds		76 mm ø NX COREHOLE	2	99	62	+100
12.0	Chert nodules at:			3	100	96	+100
14.0				4	99	39	+100
		171.65					
16.0	DOLOMITE (GASPORT MEMBER, LOCKPORT FORMATION): massive, gray, fine to medium grained, porous	*170.61*		5	102	56	+100
18.0	DOLOMITE (DECEW FORMATION): massive, fine grained, greenish gray, some shaley beds, irregular bedding			6	100	83	+100
20.0		*167.28*					
	SHALE (ROCHESTER FORMATION): black to gray, fine grained, brittle, thinly bedded, close fractures, interbedded with thin bioclastic dolomite and limestone beds, fossiliferous			7	100	79	+100
22.0		*164.79*					
24.0	LIMESTONE (IRONDEQUOIT FORMATION): massive, gray, medium grained, crystalline, porous, trace fossils, trace calcite, and silica on fractures			8	98	46	+100

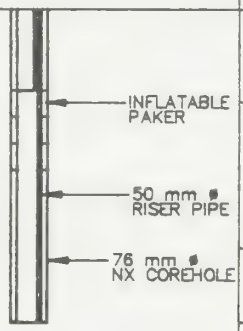
NOTES:

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

PROJECT NAME: UPPER OTTAWA STREET LANDFILL
HOLE DESIGNATION: OW4–87 (PAGE 2 of 2)
PROJECT NO.: 2184–10
DATE COMPLETED: 16/12/87
CLIENT: REGIONAL MUNICIPALITY OF HAMILTON WENTWORTH
DRILLING METHOD: AIR CORE
LOCATION: 30 m SOUTH OF UW12
CRA SUPERVISOR: L. LEMON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
m BG		m AMSL			%	%	%
24.0							
26.0	LIMESTONE (IRONDEQUOIT FORMATION): massive, gray, medium grained, crystalline, porous, trace fossils, trace calcite, and silica on fractures			8	98	46	+100
		160.14					
28.0	SHALEY DOLOMITE (REYNALES FORMATION, UPPER MEMBER): very fine grained, thinly bedded to massive, pale green, shaley partings, trace pyrite nodules			9	100	87	+100
		157.78					
30.0	DOLOMITE (REYNALES FORMATION, LOWER MEMBER): massive bedded, fine to medium grained, buff, fossiliferous, pyrite nodules, sharp bedding contracts	*157.25*		10	92	60	+100
32.0	SANDSTONE (THOROLD FORMATION) thinly bedded, fine grained, green, trace shaley laminae, thin dolomitic or conglomerate beds	*156.80*					
34.0	END OF HOLE AT 30.48 m BGS						
36.0	NOTES: 1. Fracture occurrences and core breaks are detailed on separate forms. 2. Core from Run 6 was dropped on removal from core tube and may not have been reassembled accurately.						
38.0							
40.0							
42.0							
44.0							
46.0							
48.0							



NOTES:
▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

APPENDIX B

FRACTURE FREQUENCY DISTRIBUTION

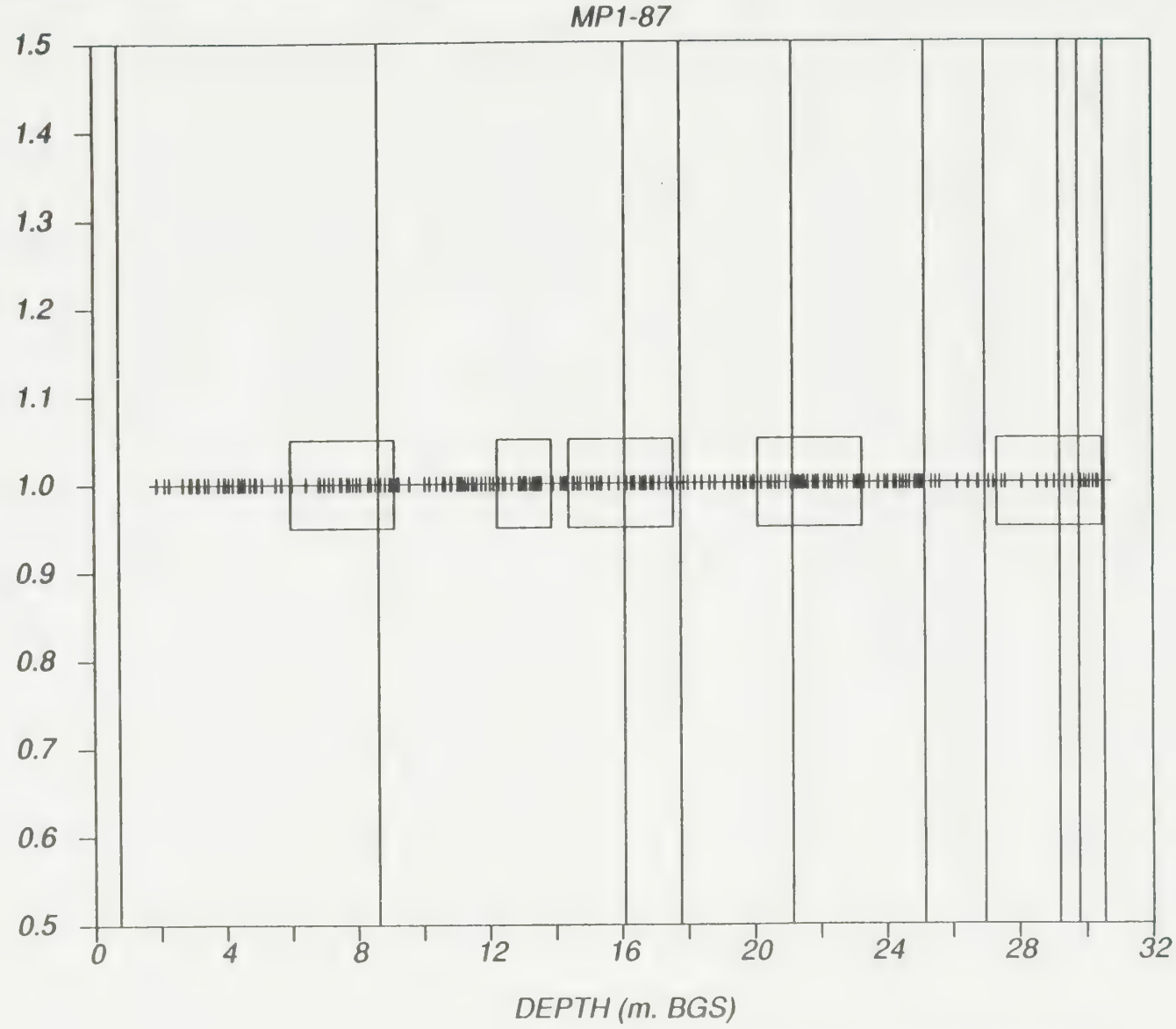


figure B.1

MP1–87 FRACTURE FREQUENCY DISTRIBUTION
UPPER OTTAWA STREET LANDFILL
Regional Municipality of Hamilton – Wentworth

CRA

2184-30-24/01/89-5-0

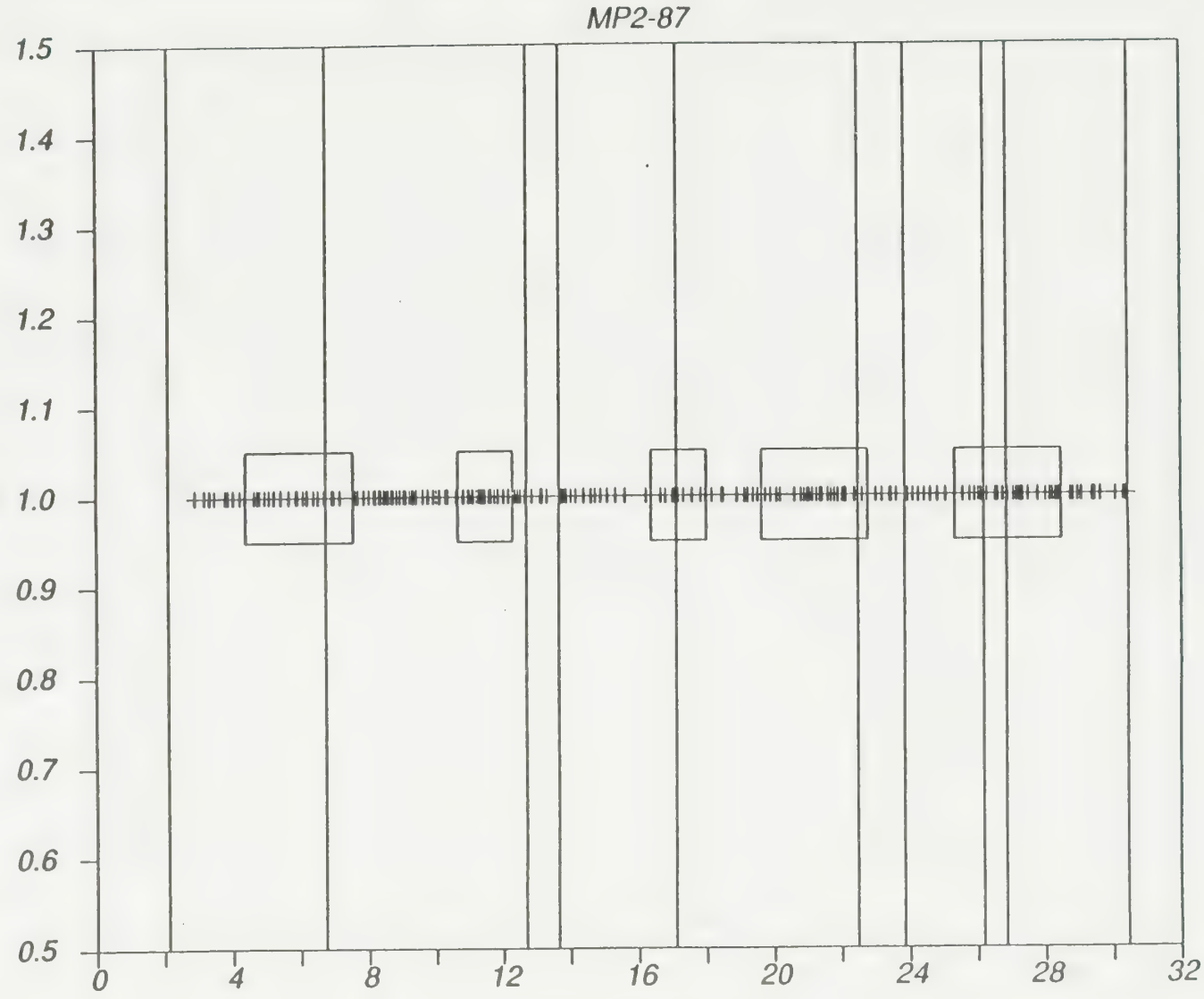


figure B.2

MP2–87 FRACTURE FREQUENCY DISTRIBUTION
UPPER OTTAWA STREET LANDFILL
Regional Municipality of Hamilton – Wentworth

CRA

2184–30–24/01/89–5–0

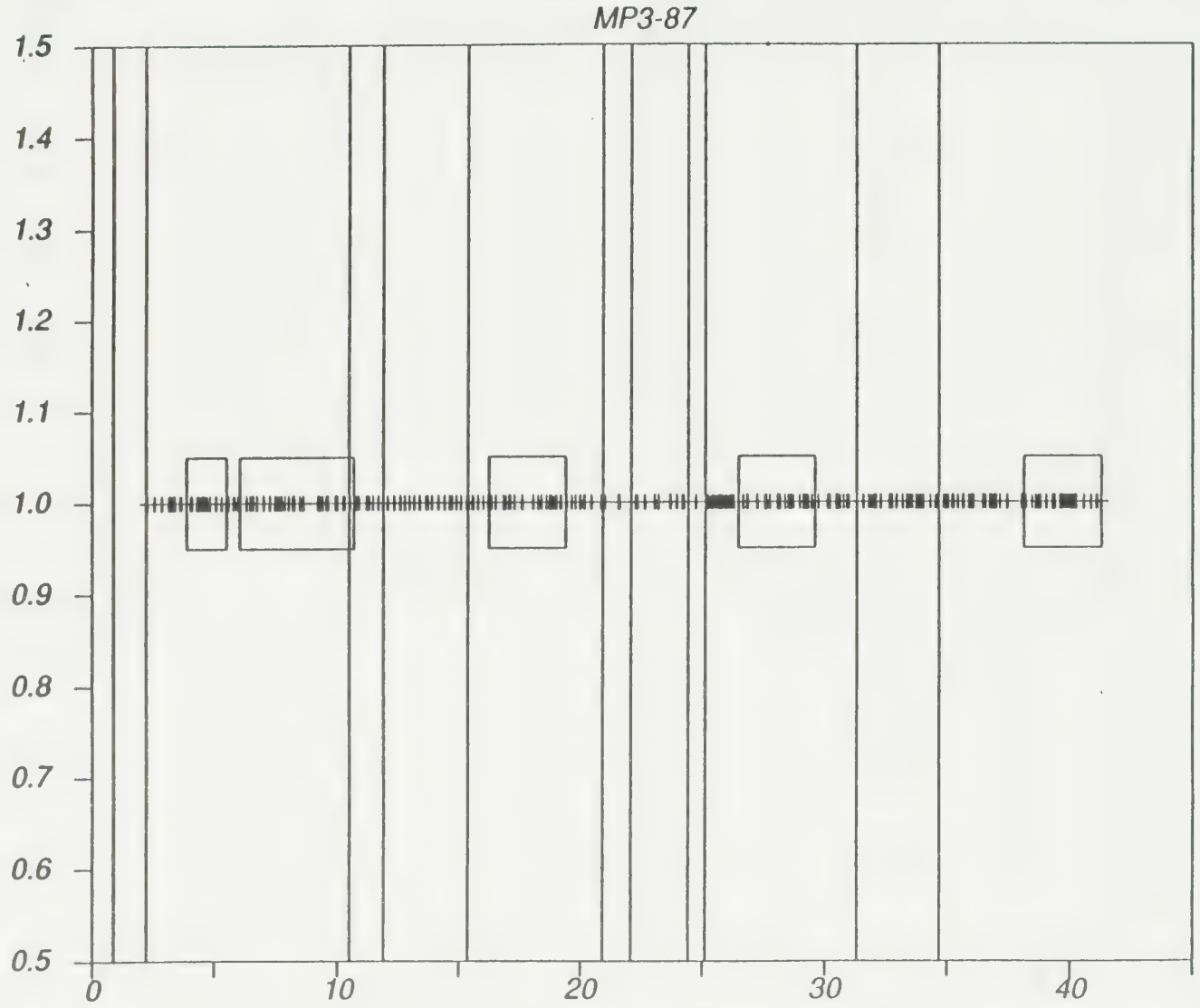


figure B.3

MP3–87 FRACTURE FREQUENCY DISTRIBUTION
UPPER OTTAWA STREET LANDFILL
Regional Municipality of Hamilton – Wentworth

CRA

2184-30-24/01/89-5-0

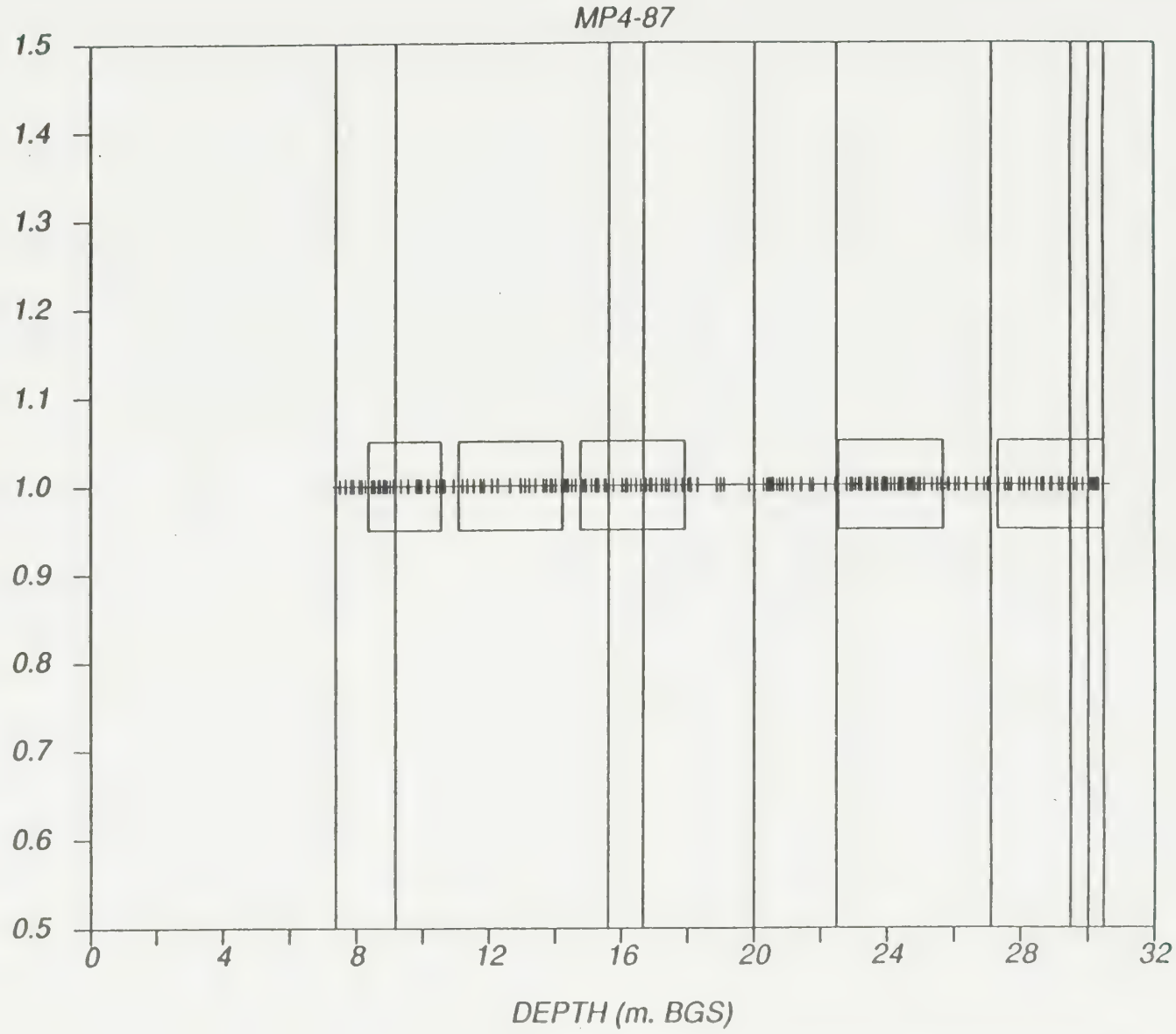


figure B.4

MP4–87 FRACTURE FREQUENCY DISTRIBUTION
UPPER OTTAWA STREET LANDFILL
Regional Municipality of Hamilton – Wentworth

CRA

2184–30–24/01/89–5–0

APPENDIX C

WELL DEVELOPMENT AND STABILIZATION RECORDS

2184 30
MONITORING DATA

SAMPLE COLLECTION DATA SHEET - GROUNDWATER SAMPLING PROGRAM

PROJECT NAME Upper OTTAWA L.F.S
PROJECT NO. 2184-30
SAMPLING CREW MEMBERS K VanderMeulen, R Woods, R Waller
SUPERVISOR
DATE OF SAMPLE COLLECTION JUNE 1, 2, 3, 6, 7, 8, 9, 20/88

Sample I.D. Number	Well Number	Measuring Point Elev.	Bottom Depth	Water Depth (m)	Water Elevation	Well Volume (liters)	Bailer Volume/ No. Bails	Volume Purged (liters)	Field pH	Field Temp.	Field Cond.	COMMENTS
	MP1-1			19.330								300ml 5min Recharge
	1-2			16.705								500ml 5min-250ml
	1-3			5.385								1000ml
	1-4			7.132								150ml - DRY 4 DAY RECHARGE
	1-5			3.374								150ml - 5min RECHARGE
	MP2-1			11.430								500ml 5min RECHARGE
	2-2			8.323								700ml 5min-300ml
	2-3			8.432								150ml Every 5min
	2-4			4.694								150ml Every 5min

ADDITIONAL COMMENTS:

COPIES TO: Chris Gallinski, Mike Matejk

SAMPLE COLLECTION DATA SHEET - GROUNDWATER SAMPLING PROGRAM

PROJECT NAME Upper Ottawa L.F.S. PROJECT NO. 2184-30
SAMPLING CREW MEMBERS K. VanderMeulen, R Woods, R Waller SUPERVISOR
DATE OF SAMPLE COLLECTION June 1,2,3,6,7,8,9,20/88

Sample I.D. Number	Well Number	Measuring Point Elev.	Bottom Depth	Water Depth (m)	Water Elevation	Well Volume (liters)	Bailer Volume/ No. Bails	Volume Purged (liters)	Field pH	Field Temp.	Field Cond.	COMMENTS
	MP 2-5			3.725								150ml Every 5min
	MP 3-1			3.587								1000ml
	3-2			10.158								400ml Every 5min
	3-3			5.210								400ml - 24hr Recharge
	3-4			2.578								300ml 5min - 200ml
	3-5			2.197								150ml Every 5min
	MP H-1			8.671								1000ml
	4-2			8.770								150ml 5min 150ml then water overflowed - water flowed for 4 days
	4-3			8.210								GOT NOTHING - WATER CAME OUT OF 4-4

ADDITIONAL COMMENTS: _____

SAMPLE COLLECTION DATA SHEET - GROUNDWATER SAMPLING PROGRAM

PROJECT NAME: UPPER OTTAWA L.E.S. PROJECT NO. 2184-30
SAMPLING CREW MEMBERS: K VanderMeulen, R Woods, R Waller SUPERVISOR
DATE OF SAMPLE COLLECTION: JUNE 1,2,3,6,7,8,9,20/88

Sample I.D. Number	Well Number	Measuring Point Elev.	Bottom Depth	Water Depth (m)	Water Elevation	Well Volume (liters)	Bailer Volume/ No. Balls	Volume Purged (liters)	Field pH	Field Temp.	Field Cond.	COMMENTS
	MP 4-4			7.220								TOOK SAMPLE WITH SYSTEM IN 4-3
	4-5			7.385								50ml Every 5min
	SW1											FLOW: 10'x6" 10' = 6sec
	SW2											FLOW: 10'x6" 10' = 6sec

ADDITIONAL COMMENTS:

COPIES TO: Chris G. Mike M

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.F.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 3/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP 3-1
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 3.52m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 3.15m
SCREENED INTERVAL
WELL VOLUME 5.1 l

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	4L	200ml	200ml	200ml		
FIELD pH						
FIELD TEMPERATURE						
FIELD CONDUCTIVITY						
CLARITY						
COLOR	Black	Black	Black	Black		
ODOR	Strong Sulphurous	→	→	→		
COMMENTS	very turbid	→	→	→		

COPIES TO: C. Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.F.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 3/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP 3-2
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 6.07m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 3.16m
SCREENED INTERVAL
WELL VOLUME 5.16 l

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT / AVG
VOLUME PURGED (# bails/tot. volume)	300ml	400ml	500ml	400ml	400ml	
FIELD pH						
FIELD TEMPERATURE						
FIELD CONDUCTIVITY						
CLARITY						
COLOR	Black	→	→	→	→	
ODOR	Strong Sulphurous	→	→	→	→	
COMMENTS	very turbid	→	→	→	→	

COPIES TO: Chris Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.F.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 3/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP3-3
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 5.31m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 3.15m
SCREENED INTERVAL
WELL VOLUME 5.1l

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	500ml	700ml	900ml	850ml		
FIELD pH	6.22	6.53	6.47	6.40		
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	18800	20000	27200	37600		
CLARITY						
COLOR	Black	lt grey	→	→		
ODOR	St. Sulphurous	→	→	→		
COMMENTS	very turbid	turbid	→	→		

COPIES TO: C Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.F.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 3/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP 3-4
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 2.395m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 4.63m
SCREENED INTERVAL
WELL VOLUME 7.57ℓ

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	500ml	100ml	200ml			
FIELD pH	6.59					
FIELD TEMPERATURE —						
FIELD CONDUCTIVITY —	13000					
CLARITY						
COLOR	dk grey	1+ grey	1+ grey			
ODOR	S+ Sulphurous	→	→			
COMMENTS	turbid	→	→			

COPIES TO: C. Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.E.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 3/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP 3-5
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 2.085 m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 1.63 m
SCREENED INTERVAL
WELL VOLUME 2.66 l

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	300ml	DRY (after 15 min)				
FIELD pH	6.53					
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	14700					
CLARITY						
COLOR	lt grey					
ODOR	St Sulphurous					
COMMENTS	turbid					

COPIES TO: C. Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.F.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 3/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MPH-1
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 9.39m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 3.15m
SCREENED INTERVAL
WELL VOLUME 5.1 ℓ

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	2300ml	400ml	400ml	150ml		
FIELD pH	7.10	6.79	6.66	6.94		
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	10200	95800	106300	120500		
CLARITY						
COLOR	very lt grey	→	→	→		
ODOR	Str. Sulphurous	→	→	→		
COMMENTS	turbid	→	→	→		

COPIES TO: Chris Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.E.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 6/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP4-2
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 7.72m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 3.15m
SCREENED INTERVAL
WELL VOLUME 5.1l

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT / AVG
VOLUME PURGED (# bails/tot. volume)	750ml	900ml	1200ml	1200ml	800ml	
FIELD pH	6.84	6.85	6.79	6.80	6.81	
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	18400	46200	62200	65700	70100	
CLARITY						
COLOR	Black	1+ grey	→	→	→	
ODOR	S+ Sulphurous	→	→	→	→	
COMMENTS	S1 turbid	→	→	→	→	

COPIES TO: C Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.E.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 6/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MPH-3
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 7.73m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 3.16m
SCREENED INTERVAL
WELL VOLUME 5.2 l

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	800ml	400ml	500ml	600ml		
FIELD pH	6.86	6.91	6.90	7.01		
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	13900	14100	25700	27200		
CLARITY						
COLOR	Grey	l+ grey	l+ grey	white grey		
ODOR	Sulphurous	Sulphurous	S+ Sulphurous	S+ Sulphurous		
COMMENTS	Sl turbid	turbid	turbid	Sl turbid		

COPIES TO: C Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.F.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 6/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP4-4
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 7.15m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 3.13m
SCREENED INTERVAL
WELL VOLUME 5.1ℓ

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	350ml	250ml				
FIELD pH	6.91	7.18				
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	13000	23400				
CLARITY						
COLOR	dk grey	grey				
ODOR	st Sulphurous	st Sulphurous				
COMMENTS	sl turbid	sl turbid				

COPIES TO: C Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.F.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 6/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MPH-5
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 7.36m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 2.19m
SCREENED INTERVAL
WELL VOLUME 3.6 l

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT / AVG
VOLUME PURGED (# bails/tot. volume)	200ml	200ml				
FIELD pH	7.26	7.54				
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	15900	8100				
CLARITY						
COLOR	Grey	Grey				
ODOR	St Sulphurous	St Sulphurous				
COMMENTS	Sl turbid	Sl turbid				

COPIES TO: C Galinski

~~6218~~ 4-30
MONITORING DATA

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.E.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 6/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP1-1
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 20.30m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 3.15m
SCREENED INTERVAL
WELL VOLUME 5.2l

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	350ml	350ml	1400ml	900ml		
FIELD pH	6.02	6.34	6.19	6.44	"	
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	90400	94400	93300	88100		
CLARITY						
COLOR	1+ grey	grey	black	black		
ODOR	Sulphurous	"	"	"		
COMMENTS	SI turbid	turbid	"	"		

COPIES TO: Chris Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.E.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 6/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP1-2
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 16.23m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 3.16m
SCREENED INTERVAL
WELL VOLUME 5.2l

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT / AVG
VOLUME PURGED (# bails/tot. volume)	600ml	700ml	350ml	350ml		
FIELD pH	5.84	6.36	6.51	6.56	:	
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	101400	110300	111400	115000		
CLARITY						
COLOR	whitish	→	→	→		
ODOR	Sulphurous	→	→	→		
COMMENTS	SI turbid	→	→	→		

COPIES TO: C Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.F.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 6/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP 1-3
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 6.91 ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 3.16
SCREENED INTERVAL
WELL VOLUME 5.2 l

Note: For 2" dia well, 1 foot= 0.14 gallons(Imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	900ml	300ml	200ml			
FIELD pH	6.05	6.27	6.39			
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	17500	18100	19100			
CLARITY						
COLOR	Black	Black/Grey	lt grey			
ODOR	St Sulphurous	→	→			
COMMENTS	very turbid	turbid	turbid			

COPIES TO: C. Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.E.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 7/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP 1-4
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 10.34m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 1.63m
SCREENED INTERVAL
WELL VOLUME 2.67ℓ

Note: For 2" dia well, 1 foot= 0.14 gallons(Imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT / AVG
VOLUME PURGED (# bails/tot. volume)	200ml	200ml				
FIELD pH	6.67	7.23				
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	36400	52500				
CLARITY						
COLOR	Grey	Grey				
ODOR	S+ Sulphurous	S+ Sulphurous				
COMMENTS	turbid	turbid				

COPIES TO: C Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.F.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 188
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP1-5
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 3.24m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 3.16m
SCREENED INTERVAL -
WELL VOLUME 5.2l

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT / AVG
VOLUME PURGED (# bails/tot. volume)	400ml	DRY (after 20min)				
FIELD pH	6.81				t	
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	9800					
CLARITY						
COLOR	Grey					
ODOR	Sulphurous					
COMMENTS	Sl turbid					

COPIES TO: C Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.F.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 8/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP2-1
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 5.0m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 3.16m
SCREENED INTERVAL
WELL VOLUME 5.2l

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	600ml					
FIELD pH	5.81					
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	12530					
CLARITY						
COLOR	whitish					
ODOR	S+ Sulphurous					
COMMENTS	very sl turbid					

COPIES TO: C Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.E.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 8/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP2-2
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 8.22m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 3.16m
SCREENED INTERVAL
WELL VOLUME 5.17 l

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	700ml					
FIELD pH	6.12					
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	meter not working					
CLARITY						
COLOR	clear					
ODOR	S+ Sulphurous					
COMMENTS	no turbidity					

COPIES TO: C Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.E.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 8/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP2-3
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH
SCREENED INTERVAL
WELL VOLUME

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	not taken out due to the lack of water recharge					
FIELD pH						
FIELD TEMPERATURE						
FIELD CONDUCTIVITY						
CLARITY						
COLOR						
ODOR						
COMMENTS						

COPIES TO: C Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.E.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 8/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP2-4
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 4.71m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH 1.63m
SCREENED INTERVAL
WELL VOLUME 2.67ℓ

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	500ml					
FIELD pH	6.27					
FIELD TEMPERATURE						
FIELD CONDUCTIVITY	meter Not working					
CLARITY						
COLOR	Clear					
ODOR	very slt Sulphurous					
COMMENTS	no turbidity					

COPIES TO: C Galinski

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME UPPER OTTAWA L.E.S PROJECT NO. 2184-30
DATE OF WELL DEVELOPMENT JUNE 8/88
DEVELOPMENT CREW MEMBERS KEN VANDERMEULEN
SUPERVISOR
PURGING METHOD

WELL INFORMATION

WELL NUMBER MP2-5
WELL TYPE (diameter/material) MULTILEVEL PIEZOMETERS
MEASURING POINT ELEVATION
STATIC WATER DEPTH 3.625m ELEVATION
BOTTOM DEPTH ELEVATION
WATER COLUMN LENGTH
SCREENED INTERVAL
WELL VOLUME

Note: For 2" dia well, 1 foot= 0.14 gallons(imp) or 0.16 gallons(us).
1 meter= 2 liters.

DEVELOPMENT DATA

	1	2	3	4	5	TOT/AVG
VOLUME PURGED (# bails/tot. volume)	water not taken out due to lack of water recharge.					
FIELD pH						
FIELD TEMPERATURE						
FIELD CONDUCTIVITY						
CLARITY						
COLOR						
ODOR						
COMMENTS						

COPIES TO: C Galinski

SAMPLE COLLECTION DATA SHEET - GROUNDWATER SAMPLING PROGRAM

PROJECT NAME UPPER OTTAWA L.F.S. PROJECT NO. 2184-30

SAMPLING CREW MEMBERS J Nickel, R WALLER SUPERVISOR

DATE OF SAMPLE COLLECTION Sept 12, 14, 15, 16, 23 / 88

SAMPLE I.D. NUMBER	WELL NUMBER	T.O.C. ELEVATION	WELL DEPTH	WATER DEPTH m	WATER ELEVATION	WELL VOLUME	VOLUME PURGED	FIELD pH	FIELD TEMP.	FIELD COND.	TIME	COMMENTS
1-1	MP1-1			18.480				5.63		>20,000	7:30A 09/23/88	
1-2	1-2			16.635				5.80		>20,000	8:45A 09/23/88	
1-3	1-3			3.455				6.14		>20,000	9:50A 09/23/88	
1-4	1-4			3.975				6.15		>20,000	09/15/88	
1-5	1-5			3.440				6.85		9,000	11:00A 09/23/88	
2-1	MP2-1			11.895				6.03		>20,000	09/15/88	
2-2	2-2			8.560				6.14		>20,000	09/15/88	
2-3	2-3			5.625				6.50		>20,000	09/15/88	
2-4	2-4			4.080				6.76		>20,000	09/15/88	

ADDITIONAL COMMENTS

Copies To: Paul Platz, Chris Galinsky, Mike Matevk

SAMPLE COLLECTION DATA SHEET - GROUNDWATER SAMPLING PROGRAM

PROJECT NAME UPPER OTTAWA L.F.S. PROJECT NO. 2184-30

SAMPLING CREW MEMBERS J Nickel R WALLER SUPERVISOR

DATE OF SAMPLE COLLECTION Sept 12, 14, 15, 16, 23 / 88

SAMPLE I.D. NUMBER	WELL NUMBER	T.O.C. ELEVATION	WELL DEPTH	WATER DEPTH m	WATER ELEVATION	WELL VOLUME	VOLUME PURGED	FIELD pH	FIELD TEMP.	FIELD COND.	TIME	COMMENTS
	MP2-5			3.920				7.43		4470	09/15/88	
	MP 3-1			3.900				5.75		>20,000	09/15/88	
	3-2			11.000				5.82		>20,000	09/15/88	
	3-3			6.035				6.06		>20,000	09/15/88	
	3-4			2.725				6.44		>20,000	09/15/88	
	3-5			2.400				7.48		5120	09/15/88	
	MP4-1			9.410				6.21		>20,000	09/15/88	
	4-2			9.220				5.98		>20,000	8:15A 09/23/88	
	4-3			6.735				6.57		>20,000	09/15/88	

ADDITIONAL COMMENTS

Copies To: Paul P, Chris G, Mike M

SAMPLE COLLECTION DATA SHEET - GROUNDWATER SAMPLING PROGRAM

PROJECT NAME UPPER OTTAWA L.F.S. PROJECT NO. 2184-30
SAMPLING CREW MEMBERS J Nickel, R WALLER SUPERVISOR
DATE OF SAMPLE COLLECTION Sept 12, 14, 15, 16, 23 / 88

SAMPLE I.D. NUMBER	WELL NUMBER	T.O.C. ELEVATION	WELL DEPTH	WATER DEPTH m	WATER ELEVATION	WELL VOLUME	VOLUME PURGED	FIELD pH	FIELD TEMP.	FIELD COND.	TIME	COMMENTS
4-4	MPH-4			6.730				6.60		>20,000	09/15/88	
4-5	4-5			7.515				7.10		8950	10:00A 09/16/88	
Leach MH	MH32							12.45		14,240	9:25A 09/16/88	Location 32
SEEP1	SEEP1							7.58		11,250	11:30A 09/16/88	1ℓ = 2min
SEEP2	SEEP2							7.72		11,700	12:45P 09/16/88	1ℓ = 10min (at top of seep) – seep spreads out at river into 8 sections that run into river
SP-1	SP1							7.64		1226	1:45P 09/16/88	3.5' x 12' 10' = 60sec
SP-2	SP2							7.69		1548	1:15P 09/16/88	18" x 5' 10' = 20sec

ADDITIONAL COMMENTS

Copies To: Paul P, Chris G, Mike M

APPENDIX D

1988 MONITORING PROGRAM

APPENDIX D

1988 MONITORING PROGRAM
UPPER OTTAWA STREET LANDFILL MONITORING 1988

Contact: Mike Mateyk or Chris Galinski

The 1988 Upper Ottawa Street Landfill monitoring program consists of the following components:

- surface water and sediment sampling of Redhill Creek
- leachate and leachate seep monitoring
- groundwater monitoring

Target Analytical Facility: NovaLab

NOTE: QA/QC sampling will **NOT** be conducted as part of this program.
VOC trip blank to be collected for each monitoring round.
Attached parameter lists must be followed with no omissions.
All sampling protocols taken from the proposal "Environmental Monitoring (Item II), Upper Ottawa Street Landfill Site", dated June 1987, and are attached.

Revised June 24, 1988

1.0 SURFACE WATER and SEDIMENT MONITORING

1.1 Locations: as per Figure 3.2, 2 (two) locations along Redhill Creek

1.2 Frequency: June and September

1.3 Monitoring:

1. measure flow rate accurately at each location and record as L/sec or gpm
2. sample for stream for parameters listed on Table D-2. Stream to be sampled on two occassions: June and September.
3. sample sediment for parameters listed on Table D-3. Sediment to be sampled in June only.

1.4 Sampling Requirements (Bottles)

TYPE OF BOTTLE/JAR	QUANTITY
A. WATER	
A 1. VOC: 2 surface water	2
A 2. BNAE: 2 surface water	2
B. SEDIMENT	
B 1. PCB: 2 sediment samples	2
B 2. PAH: 2 sediment samples	2

2.0 LEACHATE and LEACHATE SEEP MONITORING

2.1 Location: as per Figure 3.1, 3 (three) locations
- two seeps along the north side of the Site
- one manhole at Location 32 (Figure 6)

2.2 Frequency: June and September

2.3 Monitoring:
1. estimate flow rate at each leachate seep and record as L/sec or gpm
2. sample leachate seeps along north side of Site for parameters on Table D-1.
3. sample for manhole at Location 32 for parameters listed on Table D-1.

2.3 Sampling Requirements (Bottles)

TYPE OF BOTTLE	QUANTITY
1. VOC: 2 leachate seeps, 1 manhole	3
2. BNAE: 2 leachate seeps, 1 manhole	3
3. PESTICIDES and PCB: 2 leachate seeps, 1 manhole	3

3.0 GROUNDWATER MONITORING

3.1 Location: as per Figure 3.3 and Figure 1, 6 (six) locations
MP1-88, MP2-88, MP3-88, MP4-88, UW15, UW16
The 1988 series of installations are replacement wells. They are identified as follows:

MP1-88 replaces UW7
MP2-88 replaces UW9
MP3-88 replaces UW12
MP4-88 replaces UW22

The actual field locaton of the MP series of piezometers may differ from that presented on Figure 3.3. The completion details for the MP series of piezometers is presented on Table 1

3.2 Frequency: June and September

3.3 Monitoring:
1. measure water level at each multilevel piezometer at each nest identified in item 3.1
2. Sample for groundwater in the MP series of piezometers for the parameters on Table D-4

3.4 Sampling Requirements (Bottles)

TYPE OF BOTTLE	QUANTITY
1. VOC: 20 multilevel piezometers	20
2. BNAE: 20 multilevel piezometers	20

TABLE D-1

LEACHATE MONITORING PARAMETERS

I. VOLATILE COMPOUNDS	METHOD NUMBER (1)	TARGETED DETECTION LIMIT
Benzene	8240	1 ug/L
Bromomethane	8240	1 ug/L
Bromodichloromethane	8240	1 ug/L
Bromoform	8240	1 ug/L
Carbon Tetrachloride	8240	1 ug/L
Chlorobenzene	8240	1 ug/L
Chloroethane	8240	1 ug/L
2-Chloroethylvinyl ether	8240	1 ug/L
Chloroform	8240	1 ug/L
Chloromethane	8240	1 ug/L
Dibromochloromethane	8240	1 ug/L
1,1-Dichloroethane	8240	1 ug/L
1,2-Dichloroethane	8240	1 ug/L
1,1-Dichloroethylene	8240	1 ug/L
trans-1,2-Dichloroethylene	8240	1 ug/L
1,2-Dichloropropane	8240	1 ug/L
cis-1,3-Dichloropropene	8240	1 ug/L
trans-1,3-Dichloropropene	8240	1 ug/L
Ethylbenzene	8240	1 ug/L
Methylene chloride	8240	1 ug/L
1,1,2,2-Tetrachloroethane	8240	1 ug/L
Tetrachloroethylene	8240	1 ug/L
1,1,1-Trichloroethane	8240	1 ug/L
1,1,2-Trichloroethane	8240	1 ug/L
Trichloroethylene	8240	1 ug/L
Toluene	8240	1 ug/L
Vinyl chloride	8240	1 ug/L
Xylenes	8240	1 ug/L

continued....

TABLE D-1

LEACHATE MONITORING PARAMETERS

II. BASE/NEUTRAL COMPOUNDS	(1) METHOD NUMBER	TARGETED DETECTION LIMIT
PAHs		
Acenaphthene	8270	1 ug/L
Acenaphthylene	8270	1 ug/L
Anthracene	8270	1 ug/L
Benzo(a)anthracene	8270	1 ug/L
Benzo(b)fluoranthene	8270	1 ug/L
Benzo(k)fluoranthene	8270	1 ug/L
Benzo(a)pyrene	8270	1 ug/L
Benzo(g,h,i)perylene	8270	1 ug/L
Chrysene	8270	1 ug/L
Dibenzo(a,h)anthracene	8270	1 ug/L
Fluoranthene	8270	1 ug/L
Fluorene	8270	1 ug/L
Indeno(1,2,3-cd)pyrene	8270	1 ug/L
Naphthalene	8270	1 ug/L
Phenanthrene	8270	1 ug/L
Pyrene	8270	1 ug/L
Ethers and Esters		
Bis(2-chloroethyl)ether	8270	1 ug/L
Bis(2-chloroethoxy)methane	8270	1 ug/L
Bis(2-ethylhexyl)phthalate	8270	1 ug/L
Bis(2-chloroisopropyl)ether	8270	1 ug/L
4-Bromophenyl phenyl ether	8270	1 ug/L
Butyl benzyl phthalate	8270	1 ug/L
4-Chlorophenyl phenyl ether	8270	1 ug/L
Diethylphthalate	8270	1 ug/L
dimethylphthalate	8270	1 ug/L
Dioctylphthalate	8270	1 ug/L
Di-n-butylphthalate	8270	1 ug/L
Isophorone	8270	1 ug/L

continued....

TABLE D-1

LEACHATE MONITORING PARAMETERS

II. BASE/NEUTRAL COMPOUNDS	(1) METHOD NUMBER	TARGETED DETECTION LIMIT
Nitrogen Containing Compounds		
Benzidine	8270	1 ug/L
2,4-Dinitrotoluene	8270	1 ug/L
2,6-Dinitrotoluene	8270	1 ug/L
1,2-Diphenylhydrazine	8270	1 ug/L
Nitrobenzene	8270	1 ug/L
N-Nitrosodimethylamine	8270	1 ug/L
N-Nitrosodi-n-phenylamine	8270	1 ug/L
Chlorinated Hydrocarbons		
2-Chloronaphthalene	8270	1 ug/L
1,3-Dichlorobenzene	8270	1 ug/L
1,4-Dichlorobenzene	8270	1 ug/L
1,2-Dichlorobenzene	8270	1 ug/L
3,3'-Dichlorobenzidine	8270	1 ug/L
Hexachlorobenzene	8270	1 ug/L
Hexachlorobutadiene	8270	1 ug/L
Hexachloroethane	8270	1 ug/L
Hexachlorocyclopentadiene	8270	1 ug/L
2,3,7,8-Tetrachlorodibenzo-p-dioxin	8270	1 ug/L
1,2,4-Trichlorobenzene	8270	1 ug/L
Acid Compounds		
4-Chloro-3-methylphenol	8270	1 ug/L
2-Chlorophenol	8270	1 ug/L
2,4-Dichlorophenol	8270	1 ug/L
2,4-Dimethylphenol	8270	1 ug/L
2,4-Dinitrophenol	8270	1 ug/L
2-methyl-4,6-dinitrophenol	8270	1 ug/L
2-Nitrophenol	8270	1 ug/L
4-Nitrophenol	8270	1 ug/L
Pentachlorophenol	8270	1 ug/L
Phenol	8270	1 ug/L
2,4,6-Trichlorophenol	8270	1 ug/L

continued

TABLE D-1

LEACHATE MONITORING PARAMETERS

III. PESTICIDES AND PCBs	METHOD NUMBER (1)	TARGETED DETECTION LIMIT
Aldrin	8080	0.01 ug/L
Alpha-BHC	8080	0.01 ug/L
Beta-BHC	8080	0.01 ug/L
Delta-BHC	8080	0.01 ug/L
Gamma-BHC	8080	0.01 ug/L
Chlordane	8080	0.01 ug/L
4,4'-DDD	8080	0.01 ug/L
4,4'-DDE	8080	0.01 ug/L
4,4'-DDT	8080	0.01 ug/L
Dieldrin	8080	0.01 ug/L
Endosulfan I	8080	0.01 ug/L
Endosulfan II	8080	0.01 ug/L
Endosulfan Sulfate	8080	0.01 ug/L
Endrin	8080	0.01 ug/L
Endrin Aldehyde	8080	0.01 ug/L
Heptachlor	8080	0.01 ug/L
Heptachlor Epoxide	8080	0.01 ug/L
Toxaphene	8080	0.01 ug/L
PCB-1016	8080	0.01 ug/L
PCB-1221	8080	0.01 ug/L
PCB-1232	8080	0.01 ug/L
PCB-1242	8080	0.01 ug/L
PCB-1248	8080	0.01 ug/L
PCB-1254	8080	0.01 ug/L
PCB-1260	8080	0.01 ug/L

TABLE D-2

SURFACE WATER MONITORING PARAMETERS

PARAMETER	METHOD NUMBER (1)	RQL
Benzene	8240	1.0
Toluene	8240	1.0
Xylenes	8240	1.0
Ethylbenzene	8240	1.0
Trimethylbenzenes	8240	1.0
Tetramethylbenzenes	8240	1.0
Dichloromethane	8240	5.0
Dichlorobenzenes	8240	1.0
Di-n-butyl phthalate	8270	0.4
Bis(2-ethylhexyl)phthalate	8270	0.9
Phenol	8270	1.5
Cresols	8270	3.0
Xylenols	8270	2.0
Aniline	8270	
Tetrahydrofuran	8270	1.0
1,4-dioxane	8270	80.0

RQL = Reliable Quantification Limit of Analytical Method.

(1) = Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, Second Edition, SW-846, United States Environmental Protection Agency, 1984.

TABLE D-3

SEDIMENT MONITORING PARAMETERS

PCBs	METHOD NUMBER (1)	TDL
Aroclor 1016	8080	80 ug/kg
Aroclor 1221	8080	80 ug/kg
Aroclor 1232	8080	80 ug/kg
Aroclor 1242	8080	80 ug/kg
Aroclor 1248	8080	80 ug/kg
Aroclor 1254	8080	160 ug/kg
Aroclor 1260	8080	160 ug/kg
Polynuclear Aromatic Hydrocarbons		
Naphthalene	8270	330 ug/kg
Acenaphthylene	8270	330 ug/kg
Fluorene	8270	330 ug/kg
Phenanthrene	8270	330 ug/kg
Anthracene	8270	330 ug/kg
Fluoranthene	8270	330 ug/kg
Pyrene	8270	330 ug/kg
Chrysene	8270	330 ug/kg
Benzo(a)anthracene	8270	330 ug/kg
Benzo(b)fluoranthene	8270	330 ug/kg
Benzo(k)fluoranthene	8270	330 ug/kg
Benzo(a)pyrene	8270	330 ug/kg
Indeno(1,2,3-cd)pyrene	8270	330 ug/kg
Dibenz(a,h)anthracene	8270	330 ug/kg
Benzo(g,h,i)perylene	8270	330 ug/kg

TABLE D-4

GROUNDWATER MONITORING PARAMETERS

PARAMETER	METHOD NUMBER (1)	RQL
Benzene	8240	1.0
Toluene	8240	1.0
Xylenes	8240	1.0
Ethylbenzene	8240	1.0
C_3-benzenes	8240	1.0
C_4-benzenes	8240	1.0
Naphthalene	8270	0.4
Methylnaphthalenes	8270	
Dichloromethane	8240	5.0
Dichlorobenzenes	8240	1.0
Di-n-butyl phthalate	8270	0.4
Bis(2-ethylhexyl)phthalate	8270	0.9
Phenol	8270	1.5
Cresols	8270	3.0
Xylenols	8270	2.0
Aniline	8270	
Tetrahydrofuran	8270	1.0
1,4-dioxane	8270	80.0
Benxothiazole	8270	0.8

APPENDIX E

ANALYTICAL REPORTS

2184-30
MONITORING DATA

NOVALAB LTÉE LTD
9420 CÔTE DE LIESSE, LACHINE, QUE. H8T 1A1
TÉL.: (514) 636-6218, 631-1838
TÉLEX: 05-822787 • (LYNJON)
FAX: (514) 631-9814

TO: Conestoga-Rovers & Associates
86 Rankin Street
Waterloo, Ontario
N2V 1C2

Attention: Ms. D. Hayes

DATE: August 2, 1988

CLIENT ORDER #: 2184-30

REPORT #: NL-3843

RE: Analysis of Water and Soil Samples - Project 2184-30.

Ms. Hayes,

Twenty-five (25) water samples and two (2) soil samples were received June 13, 1988. Twenty (20) water samples were analysed for the volatile compounds listed in the table of groundwater monitoring parameters (table D-4) by purge and trap gc/ms (EPA method 8240). Three (3) water samples were analysed for the volatile and extractable compounds listed in the table of leachate monitoring parameters (table D-1) by gc/ms (EPA methods 8240 and 8270), and gas chromatography with electron capture detection. Two (2) water samples were analysed for the volatile and extractable compounds listed in the table of surface water monitoring parameters (table D-2) by gc/ms (EPA methods 8240 and 8270). Two (2) sediment samples were analysed for PCB and polycyclic aromatic hydrocarbons listed in the table of sediment monitoring parameters (table D-3) by gas chromatography with electron capture detection and by gc/ms (EPA method 8270). The above mentioned tables of parameters were received with the samples. Results and detection limits are shown in the attached tables.

Chromatograms will be kept on file. Results are not corrected for recovery.

Sincerely,

NOVALAB LIMITED

Lai Wa Tang, B.Sc., for J.D. Fenwick, Ph.D., P.Chem.

CHIMISTE
John D. Fenwick
74-024
QUÉBEC

LWT:sm
Encls.

NOVALAB LTÉE LTD.
9420 COTE DE LIESSE, LACHINE, QUE. H8T 1A1

NL-3843

Concentration of PCB and Organochlorinated Pesticides in Water(μg/L)

Compound	Manhole 32	Deep 1	Deep 2	MDL
HCB	N.D.	N.D.	N.D.	0.005
Heptachlor	N.D.	N.D.	N.D.	0.005
Aldrin	N.D.	N.D.	N.D.	0.005
p,p'-DDE	N.D.	N.D.	N.D.	0.02
Mirex	N.D.	N.D.	N.D.	0.05
α-BHC	N.D.	N.D.	N.D.	0.005
β-BHC	N.D.	N.D.	N.D.	0.005
Lindane	N.D.	N.D.	N.D.	0.01
Heptachlor Epoxide	N.D.	N.D.	N.D.	0.005
cis-Chlordane	N.D.	N.D.	N.D.	0.005
trans-Chlordane	N.D.	N.D.	N.D.	0.005
p,p'-DDD	N.D.	N.D.	N.D.	0.05
p,p'-DDT	N.D.	N.D.	N.D.	0.05
p,p-DDD	N.D.	N.D.	N.D.	0.05
p,p-DDT	N.D.	N.D.	N.D.	0.05
Methoxychlor	N.D.	N.D.	N.D.	0.1
α-Endosulfan	N.D.	N.D.	N.D.	0.02
Dieldrin	N.D.	N.D.	N.D.	0.02
Endrin	N.D.	N.D.	N.D.	0.03
β-Endosulfan	N.D.	N.D.	N.D.	0.03
δ-BHC	N.D.	N.D.	N.D.	0.005
Endosulfan Sulfate	N.D.	N.D.	N.D.	0.05
Endrin Aldehyde	N.D.	N.D.	N.D.	0.02
Toxaphene	N.D.	N.D.	N.D.	0.5
Aroclor 1242	N.D.	N.D.	N.D.	0.05
Aroclor 1248	N.D.	N.D.	N.D.	0.05
Aroclor 1254	0.07	0.81	N.D.	0.02
Aroclor 1260	N.D.	N.D.	N.D.	0.02

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NL-3843

Concentration of Base/Neutral and Acid Compounds in Water(µg/L)

Compound	SP1	SP2	Blank	MDL
di-n-butyl phthalate	1.7	7.4	1.7	1
bis(2-ethyl hexyl)phthalate	9.1	17	12	1
Aniline	-	-	-	4
Phenol	-	-	-	1
Cresols	-	-	-	2
Xylenols	-	-	-	6

Recovery of Surrogate Standards(%)

Compound	SP1	SP2	Blank
d_5-phenol	43.4	47.1	44.5
Trifluoromethyl n-cresol	90.1	88.1	95.1
d_5-nitrobenzene	93.3	86.4	85.1
d_{10}-anthracene	82.1	72.9	81.3
d_{12}-perylene	62.1	66	100

Concentration of PCB in Soil Samples(µg/g)

Compound	SP1	SP2	MDL
Aroclor 1242	N.D.	N.D.	0.01
Aroclor 1248	0.05	N.D.	0.01
Aroclor 1254	0.05	N.D.	0.01
Aroclor 1260	N.D.	N.D.	0.01

CONCENTRATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL
ug/g

COMPOUND	SP1	SP2	BLANK	MDL
ACENAPHTHENE	0.02	0.03	-	0.01
ACENAPHTHYLENE	-	-	-	0.01
ANTHRACENE	0.08	0.2	-	0.01
BENZ(A)ANTHRACENE	0.5	0.84	-	0.01
BENZO(B)FLUORANTHENE]				
BENZO(K)FLUORANTHENE]	0.4	0.5	-	0.01
BENZO(A)PYRENE	0.25	0.4	-	0.01
BENZO(GHI)PERYLENE	0.2	0.2	-	0.02
CHRYSENE	0.09	0.14	-	0.01
DIBENZ(A,H)ANTHRACENE	0.05	0.08	-	0.02
FLUORANTHENE	0.74	1.4	-	0.01
FLUORENE	0.04	0.06	-	0.01
INDENO(1,2,3-CD)PYRENE	0.2	0.3	-	0.02
NAPHTHALENE	0.02	0.04	-	0.01
PHENANTHRENE	0.5	0.8	-	0.01
PYRENE	0.56	1	-	0.01

MDL = METHOD DETECTION LIMIT

RECOVERY OF SURROGATE STANDARDS
(%)

COMPOUND	SP1	SP2	BLANK
D8-NAPHTHALENE	27.3	22.4	15.3
D10-ANTHRACENE	100	95.6	65.3
D10-FLUORANTHENE	76.5	77.6	67
D12-PERYLENE	75.7	69.3	80.2

CONCENTRATION OF BASE/NEUTRAL PRIORITY POLLUTANTS IN WATER
ug/L

COMPOUND	MANHOLE 32	SEEP 1	SEEP 2	LAB BLANK	MDL
ACENAPHTHENE	-	3.5	-	-	2
ACENAPHTHYLENE	-	-	-	-	2
ANTHRACENE	-	1	-	-	2
BENZIDINE	-	-	-	-	40
BENZ(A)ANTHRACENE	-	-	-	-	2
CHRYSENE	-	-	-	-	4
BENZO(B)FLUORANTHENE]					
BENZO(K)FLUORANTHENE]	-	-	-	-	4
BENZO(A)PYRENE	-	-	-	-	4
BENZO(GHI)PERYLENE	-	-	-	-	8
BENZYL BUTYL PHTHALATE	-	-	-	-	2
BIS(2-CHLOROETHYL)ETHER	-	-	-	-	2
BIS(2-CHLOROETHOXY)METHANE	-	-	-	-	2
BIS(2-ETHYLHEXYL)PHTHALATE	9.2	2	1.8	1.7	2
BIS(2-CHLOROISOPROPYL)ETHER	-	-	-	-	2
4-BROMOPHENYL ETHER	-	-	-	-	2
2-CHLORONAPHTHALENE	-	-	-	-	2
4-CHLOROPHENYL PHENYL ETER	-	-	-	-	2
DIBENZ(A,H)ANTHRACENE	-	-	-	-	8
DI-N-BUTYL PHTHALATE	11	12	8.3	12	2
1,3-DICHLOROBENZENE	-	-	-	-	2
1,4-DICHLOROBENZENE	-	-	-	-	2
1,2-DICHLOROBENZENE	-	-	-	-	2
3,3'-DICHLOROBENZIDINE	-	-	-	-	4
DIETHYL PHTHALATE	-	-	-	-	2
DIMETHYLPHALATE	-	-	-	-	2
2,4-DINITROTOLUENE	-	-	-	-	6
2,6-DINITROTOLUENE	-	-	-	-	6
1,2-DIPHENYLHYDRAZINE	-	-	-	-	2
DI-N-OCTYL PHTHALATE	-	-	-	-	2
FLUORANTHENE	TR	-	-	-	2
FLUORENE	-	2.9	-	-	2
HEXACHLOROBENZENE	-	-	-	-	2
HEXACHLOROBUTADIENE	-	-	-	-	6
HEXACHLOROCYCLOPENTADIENE	-	-	-	-	10
HEXACHLOROETHANE	-	-	-	-	6
INDENO(1,2,3-CD)PYRENE	-	-	-	-	8
ISOPHORONE	-	-	-	-	2
NAPHTHALENE	-	-	8	-	2
NITROBENZENE	-	-	-	-	2
N-NITROSO-DI-N-PROPYLAMINE	-	-	-	-	2
N-NITROSODIPHENYLAMINE	-	-	-	-	4
PHENANTHRENE	1.5	2.9	-	-	2
PYRENE	-	-	-	-	2
1,2,4-TRICHLOROBENZENE	-	-	-	-	2

MDL = METHOD DETECTION LIMIT

TR = TRACE
Total concentration of benzo(b)- and benzo(k)fluoranthene is shown in the row for benzo(k)fluoranthene.

CONCENTRATION OF ACIDIC PRIORITY POLLUTANTS IN WATER
ug/L

COMPOUND	MANHOLE 32	SEEP 1	SEEP 2	LAB BLANK	MDL
PHENOL	-	-	-	-	2
2-CHLOROPHENOL	-	-	-	-	2
2,4-DIMETHYLPHENOL	-	-	-	-	12
4-CHLORO-3-METHYLPHENOL	-	-	-	-	2
2,4-DICHLOROPHENOL	-	-	-	-	2
2,4,6-TRICHLOROPHENOL	-	-	-	-	2
2-NITROPHENOL	-	-	-	-	4
2,4-DINITROPHENOL	-	-	-	-	12
2-METHYL-4,6-DINITROPHENOL	-	-	-	-	10
4-NITROPHENOL	-	-	-	-	10
PENTACHLOROPHENOL	-	-	-	-	6

MDL = METHOD DETECTION LIMIT

RECOVERY OF SURROGATE STANDARDS
(%)

COMPOUND	MANHOLE 32	SEEP 1	SEEP2	LAB BLANK
D5-PHENOL	42.8	46.2	49.2	44.5
TRIFLUOROMETHYL-M-CRESOL	95.4	88.2	84.6	95.1
D5-NITROBENZENE	50.3	70.3	49.6	85.1
D10-ANTHRACENE	60.4	65.7	60.7	81.3
D12-PERYLENE	59.1	61.7	61.6	100

CONCENTRATION OF VOLATILE PRIORITY POLLUTANTS IN WATER
ug/L

COMPOUND	MANHOLE 32	SEEP 1	SEEP 2	LAB BLANK	MDL
BENZENE	3.9	28	4.7	-	1
BROMODICHLOROMETHANE	-	-	-	-	1
BROMOFORM	-	-	-	-	2
BROMOMETHANE	-	-	-	-	16
CARBON TETRACHLORIDE	-	-	-	-	2
CHLOROBENZENE	-	18	5.9	-	1
CHLOROETHANE	-	-	-	-	10
2-CHLOROETHYL VINYL ETHER	-	-	-	-	10
CHLOROFORM	2.6	-	3.5	-	1
CHLOROMETHANE	-	-	-	-	50
DIBROMOCHLOROMETHANE	-	-	-	-	1
1,2-DICHLOROBENZENE	-	4	2.6	-	1
1,3-DICHLOROBENZENE	-	8.4	-	-	1
1,4-DICHLOROBENZENE	5.9	14	5.3	-	1
1,1-DICHLOROETHYLENE	-	-	-	-	1
1,1-DICHLOROETHANE	-	-	-	-	1
1,2-DICHLOROETHANE	-	-	-	-	2
TRANS-1,2-DICHLOROETHYLENE	-	-	-	-	1
DICHLOROMETHANE	30*	20	-	-	10
1,2-DICHLOROPROPANE	-	-	-	-	1
CIS-1,3-DICHLOROPROPENE	-	-	-	-	1
TRANS-1,3-DICHLOROPROPENE	-	-	-	-	1
ETHYLBENZENE	-	120	180	-	1
A-METHYLSTYRENE	-	-	-	-	1
METHYLSTYRENE ISOMERS	8.3	250	85	-	1
MESITYLENE	3.3	40	49	-	1
1,1,2,2-TETRACHLOROETHANE	-	-	-	-	2
TETRACHLOROETHYLENE	1.1	-	-	-	1
TOLUENE	-	2.9	4.6	-	2
1,1,1-TRICHLOROETHANE	-	-	-	-	2
1,1,2-TRICHLOROETHANE	-	-	-	-	1
TRICHLOROETHYLENE	-	-	-	-	1
TRICHLOROFLUOROMETHANE	-	-	-	-	2
M+P-XYLENE	4.9	190	390	-	2
O-XYLENE	12	100	160	-	1
VINYL CHLORIDE	-	-	-	-	12
TRIMETHYLBENZENE ISOMERS **	17	450	340	-	1
TETRAMETHYLBENZENE ISOMERS **	11	290	200	-	1

MDL = METHOD DETECTION LIMITS

* Samples analysed on this date showed higher levels of dichloromethane compared to the other similar samples analysed on separate days.

** Concentrations were calculated using the response factor of mesitylene.

CONCENTRATION OF VOLATILE PRIORITY POLLUTANTS IN WATER
ug/L

COMPOUND	MP4-1	MP4-2	MP4-3	MP4-4	MP4-5	LAB BLANK	MDL
BENZENE	-	-	-	-	-	-	1
CHLOROBENZENE	-	-	-	-	-	-	1
1,2-DICHLOROBENZENE	-	-	-	-	-	-	1
1,3-DICHLOROBENZENE]	-	-	-	-	-	-	1
1,4-DICHLOROBENZENE]	-	-	-	-	-	-	1
ETHYLBENZENE	-	-	-	-	-	-	1
A-METHYLSTYRENE	-	-	-	-	-	-	1
METHYLSTYRENE ISOMERS	-	-	-	-	-	-	1
MESITYLENE	-	-	-	-	-	-	1
TOLUENE	5.4	6.7	11	8.4	-	-	2
M+P-XYLENE	-	-	-	-	-	-	2
O-XYLENE	-	-	-	-	-	-	1
TRIMETHYLBENZENE ISOMERS **	1.4	-	1.6	-	-	-	1
TETRAMETHYLBENZENE ISOMERS **	-	-	-	-	-	-	1
DICHLOROMETHANE	26*	28*	33*	31*	30*	-	10
TETRAHYDROFURAN	5.9	5.6	-	-	7	-	5
1,4-DIOXANE	-	-	-	-	-	-	150

MDL = METHOD DETECTION LIMITS

* Samples analysed on this date showed higher levels of dichloromethane compared to the other samples analysed on separate days.

** Total concentrations were calculated using the response factor of mesitylene.

CONCENTRATION OF VOLATILE PRIORITY POLLUTANTS IN WATER
ug/L

COMPOUND	MP3-1	MP3-2	MP3-3	MP3-4	MP3-5	MDL
BENZENE	6.2	3.1	8.6	5.4	1.2	1
CHLOROBENZENE	-	-	-	-	-	1
1,2-DICHLOROBENZENE	-	-	-	-	-	1
1,3-DICHLOROBENZENE]	-	-	-	-	-	1
1,4-DICHLOROBENZENE]	-	-	-	-	-	1
ETHYLBENZENE	1.2	-	2.1	1.5	-	1
A-METHYLSTYRENE	-	-	-	-	-	1
METHYLSTYRENE ISOMERS	-	-	-	-	-	1
MESITYLENE	-	-	-	-	-	1
TOLUENE	2.8	4.1	3.2	6.5	2.8	2
M+P-XYLENE	1.3	-	2.4	1.6	1.9	2
O-XYLENE	-	-	1.3	-	1	1
TRIMETHYLBENZENE ISOMERS **	1.2	-	1.6	-	4.2	1
TETRAMETHYLBENZENE ISOMERS **	-	-	-	-	1.3	1
DICHLOROMETHANE	-	-	20*	-	-	10
TETRAHYDROFURAN	160	190	120	60	30	5
1,4-DIOXANE	1400	1200	980	410	280	150

MDL = METHOD DETECTION LIMITS

* Samples analysed on this date showed higher levels of dichloromethane compared to the other samples analysed on separate days.

** Total concentrations were calculated using the response factor of mesitylene.

CONCENTRATION OF VOLATILE PRIORITY POLLUTANTS IN WATER
ug/L

COMPOUND	MP1-1	MP1-2	MP1-3	MP1-4	MP1-5	MDL
BENZENE	-	-	-	-	-	1
CHLOROBENZENE	-	-	-	-	-	1
1,2-DICHLOROBENZENE	-	-	-	-	-	1
1,3-DICHLOROBENZENE]	-	-	-	-	-	1
1,4-DICHLOROBENZENE]	-	-	-	-	-	1
ETHYLBENZENE	-	-	-	-	-	1
A-METHYLSTYRENE	-	-	-	-	-	1
METHYLSTYRENE ISOMERS	-	-	-	-	-	1
MESITYLENE	-	-	-	-	-	1
TOLUENE	9.1	5.7	12	3.8	-	2
M+P-XYLENE	-	-	-	-	-	2
O-XYLENE	-	-	-	-	-	1
TRIMETHYLBENZENE ISOMERS **	-	-	-	2.5	1.2	1
TETRAMETHYLBENZENE ISOMERS **	-	-	-	-	-	1
DICHLOROMETHANE	-	30*	-	34*	24*	10
TETRAHYDROFURAN	6.8	-	5.3	-	11	5
1,4-DIOXANE	-	-	-	-	-	150

MDL = METHOD DETECTION LIMITS

* Samples analysed on this date showed higher levels of dichloromethane compared to the other samples analysed on separate days.

** Total concentrations were calculated using the response factor of mesitylene.

CONCENTRATION OF VOLATILE PRIORITY POLLUTANTS IN WATER
ug/L

COMPOUND	SP1	SP2	MP2-1	MP2-2	MP2-3	MP2-4	MP2-5	MDL
BENZENE	-	-	1.2	-	-	-	1.5	1
CHLOROBENZENE	-	-	-	-	-	-	-	1
1,2-DICHLOROBENZENE	-	-	-	-	-	-	-	1
1,3-DICHLOROBENZENE]								
1,4-DICHLOROBENZENE]	-	-	-	-	-	-	-	1
ETHYLBENZENE	-	-	-	-	-	-	-	1
A-METHYLSTYRENE	-	-	-	-	-	-	-	1
METHYLSTYRENE ISOMERS	-	-	-	-	-	-	-	1
MESITYLENE	-	-	-	-	-	-	-	1
TOLUENE	-	-	2.2	4.2	5.3	-	2.7	2
M+P-XYLENE	-	-	-	-	-	-	-	2
O-XYLENE	-	-	-	-	-	-	-	1
TRIMETHYLBENZENE ISOMERS **	-	-	-	-	-	-	-	1
TETRAMETHYLBENZENE ISOMERS **	-	-	-	-	-	-	-	1
DICHLOROMETHANE	-	-	-	-	-	-	-	10
TETRAHYDROFURAN	6	7.1	61	48	33	8.7	130	5
1,4-DIOXANE	-	-	300	310	230	120	1100	150

MDL = METHOD DETECTION LIMITS

* Samples analysed on this date showed higher levels of dichloromethane compared to the other samples analysed on separate days.

** Total concentrations were calculated using the response factor of mesitylene.

2184-30
MONITORING DATA

NOVALAB LTÉE LTD
9420 CÔTE DE LIESSE, LACHINE, QUÉ. H8T 1A1
TÉL.: (514) 636-6218, 631-1838
TÉLEX: 05-822787 • (LYNJON)
FAX: (514) 631-9814

TO: Conestoga-Rovers & Associates
86 Rankin Street
Waterloo, Ontario
N2V 1G2

Attention: Ms. D. Hayes

DATE: August 9, 1988

CLIENT ORDER #: 2184-30

REPORT #: NL-3868

RE: Analysis of Water Samples - Project 2184-30.

Ms. Hayes,

Nineteen (19) water samples, received June 28, 1988, were analysed for the extractable compounds listed in the table of groundwater monitoring parameters received with the samples, by gc/ms (EPA method 8270). Results and detection limits are shown in the attached tables. Samples MP1-1, MP1-2 and MP3-2 were heavily emulsified during the extraction for base-neutral compounds, which possibly led to the low recoveries of the surrogate standards.

Two compounds listed in the tables, 1,4-dioxane and tetrahydrofuran, were too volatile to be analysed by the extraction method. We were able to detect these previously, during the analyses for the volatile compounds for the same set of samples. Results were shown in the tables for volatile compounds in our report NL-3843.

Chromatograms will be kept on file. Results are not corrected for recovery.

Yours sincerely,

NOVALAB LIMITED

Lai Wa Tang, B.Sc.

LWT:sm

Approved by: J.D. Fenwick, Ph.D., P.Chem.

CHIMISTE
John D. Fenwick
74-024
QUÉBEC

Concentration of Extractable Pollutants for Groundwater Monitoring(μg/L)

Compounds	MP1-3	MDL	MP3-1	MDL	MP4-1	MDL
Naphthalene	-	1	-	50	-	5
Methyl naphthalene	-	2	-	100	-	10
Di-n-butyl phthalate	7.5	1	250	50	110	5
Bis(2-ethylhexyl)phthalate	2.7	1	-	50	7.8	5
Aniline	-	10	-	4	-	20
Phenol	-	10	-	2	-	5
o-cresol	-	5	-	5	-	5
m+p-cresol	8.4	5	-	5	-	5
xylenols	-	50	-	15	-	10
Benzothiazole	79	5	15	5	6	2

Recovery of Surrogate Standards (%)

d_5-phenol	*	*	*
Trifluoromethyl m-cresol	*	*	*
d_5-nitrobenzene	50.9	*	72.8
d_{10}-anthracene	40.9	*	78.8
d_{12}-perylene	38	*	61

* Surrogate recoveries were not available due to excessive dilution required by the samples.

Concentration of Extractable Pollutants for Groundwater Monitoring(μg/L)

Compounds	MP1-1	MP1-2	MP1-4	MP1-5	MP2-1	MP2-2	MP2-3	MP2-4	MP2-5	MP3-2	MDL
Naphthalene	-	-	-	-	-	-	-	-	-	-	1
Methyl naphthalene	-	-	-	-	-	-	-	-	-	-	2
Di-n-butyl phthalate	7.6	12	6.8	4.4	6.1	180	280	350	190	470	1
Bis(2-ethylhexyl)phthalate	3.2	3.3	1.1	1.6	2.2	2.6	2.1	2	1.3	2.6	1
Aniline	-	-	Tr.	-	4	7.9	19	6.6	-	-	4
Phenol	-	-	-	-	-	-	1.2	-	-	-	1
o-cresol	-	-	-	-	-	-	21	7.5	-	-	2
m+p-cresol	-	-	-	-	-	-	3.5	2.9	-	-	2
Xylenols	-	-	-	-	-	-	-	-	180	-	6
Benzothiazole	4.8	49	160	3.1	150	15	78	18	7.4	92	2

Tr. = Trace

Recovery of Surrogate Standards (%)

d_5-phenol	42.3	49.1	38.7	34.8	37.5	36.2	43.9	40	33.5	17.3
Trifluoromethyl m-cresol	63.4	67.7	56.8	54.3	51.3	52.9	66.1	64.7	60.4	18.8
d_5-nitrobenzene	27.4	5.6	36.8	73.6	32	60.1	34.8	63	64.1	11.7
d_{10}-anthracene	18.4	5.4	20	64.2	24.2	48.3	26.9	47.7	67.3	7.2
d_{12}-anthracene	16.2	6.4	18.9	56.2	26.9	46.3	26.5	45.1	50.4	8.4

Concentration of Extractable Pollutants for Groundwater Monitoring(μg/L)

Compounds	MP3-3	MP3-4	MP3-5	MP4-2	MP4-4	MP4-5	Lab Blank #1	Lab Blank #2	MDL
Naphthalene	-	-	-	-	-	-	-	-	1
Methyl naphthalene	-	-	-	-	-	-	-	-	2
Di-n-butyl phthalate	4.6	6.4	3.7	180	240	170	5.5	120	1
Bis(2-ethylhexyl)phthalate	2	2.1	5.4	5.1	4.3	9.6	1.1	6.2	1
Aniline	-	5.9	-	13	12	-	-	-	4
Phenol	-	-	-	-	-	-	-	-	1
o-cresol	-	-	-	-	-	-	-	-	2
m+p-cresol	-	-	-	-	-	-	-	-	2
Xylenols	-	-	-	-	-	-	-	-	6
Benzothiazole	2.6	4.7	6.7	26	34	4.7	-	-	2

Recovery of Surrogate Standards (%)

d_5-phenol	20.7	28.8	30.2	6.3	33.2	46.7	45.3	49.1
Trifluoromethyl m-cresol	21.6	52.2	59.4	14	45	75.5	66	80.1
d_5-nitrobenzene	66.9	72.8	72	76	70.5	71.3	67.1	82.7
d_{10}-anthracene	82.9	80	78.8	70.6	70	77.8	76.1	88.1
d_{12}-anthracene	70.8	72.9	61	57.1	55	61.6	81.6	87.1

NOVALAB LTÉE LTD

9420 CÔTE DE LIESSE, LACHINE, QUÉ. H8T 1A1

TÉL.: (514) 636-6218, 631-1838
TÉLEX: 05-822787 • (LYNJON)
FAX: (514) 631-9814

TO: Conestoga-Rovers & Associates Ltd
86 Rankin Street
Waterloo, Ontario
N2V 1C2

Attention: Ms. D. Hayes

DATE: August 31, 1988

CLIENT ORDER #: 2184-30

REPORT #: NL-3948

RE: Additional Results for Report NL-3843 CRA Project 2184-30

Ms. Hayes,

Three (3) water samples, received June 13, 1988, were analysed for 2,3,7,8-tetrachlorodibenzo-p-dioxin by gc/ms. Surrogate standard 2,3,7,8-TCDD 13C12 was added to the sample prior to the extraction to monitor the recovery. No 2,3,7,8-TCDD was detected in any of the samples. Detection limits and surrogate standard recoveries are shown in the attached Table.

Copies of chromatograms are included.

Sincerely,

NOVALAB LIMITED

L.W. Tang, B.Sc.

Approved by J.D. Fenwick, Ph.D., P.Chem.

CHIMISTE
John D. Fenwick
74-024
QUÉBEC

LWT/hl
encl.

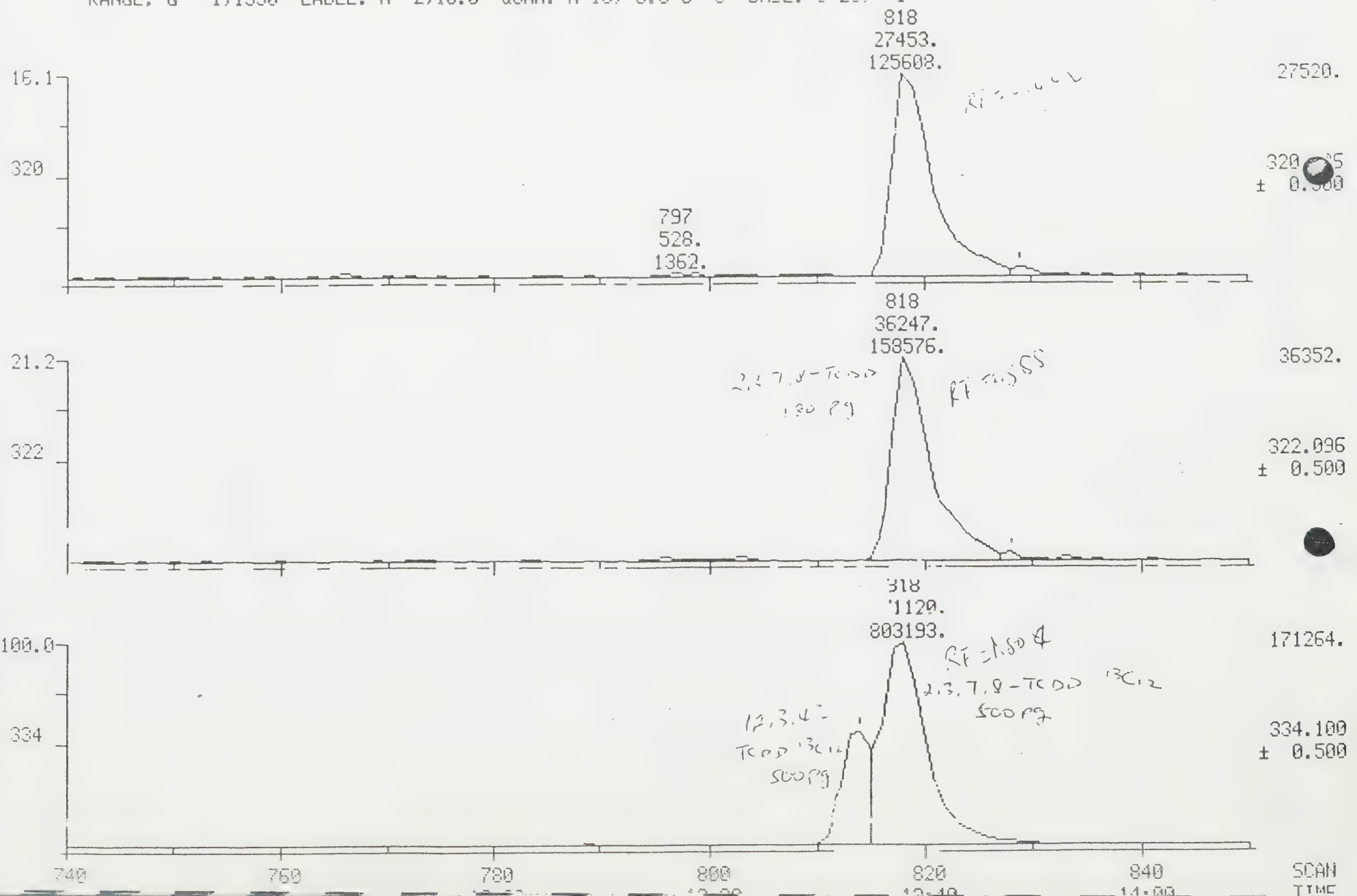
NL-3948

Concentration of 2,3,7,8-TCDD in Water Samples

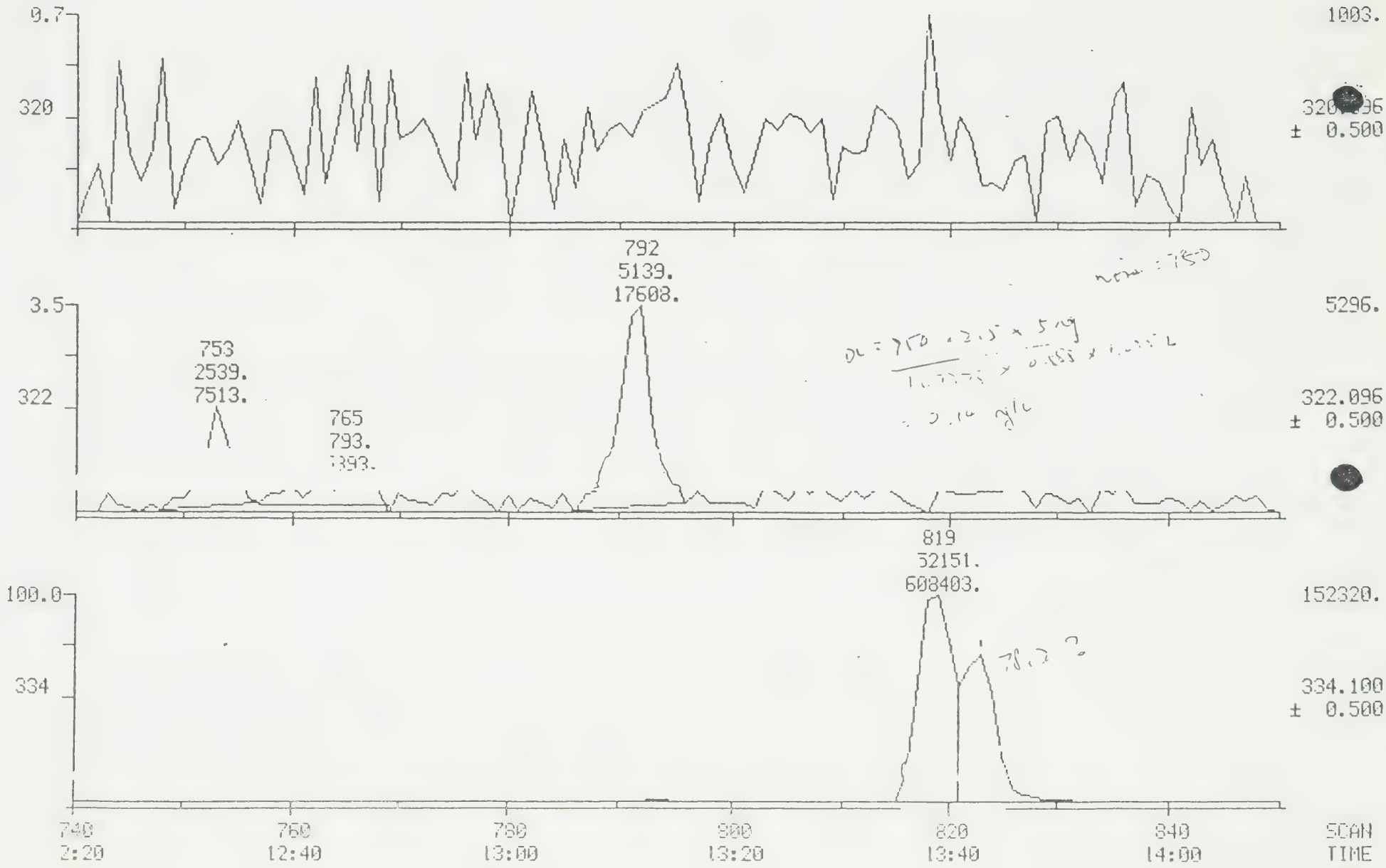
Sample	Concentration *(ng/L)	Recovery of 2,3,7,8-TCDD 13C (%)
Manhole 32	0.14	78.2
Seep #1	0.12	73.4
Seep #2	0.06	100
Blank	0.11	89.8

* Note: All values are detection limits

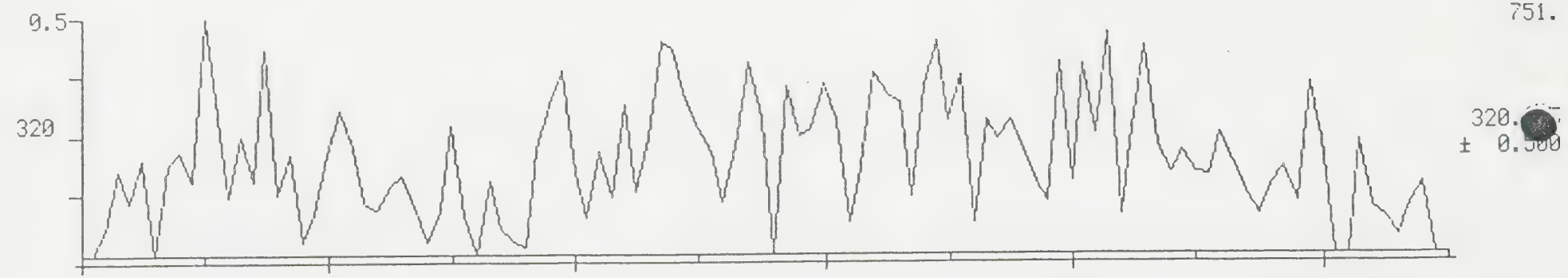
MID MASS CHROMATOGRAMS DATA: PCDDS #1 SCANS 740 TO 850
08/23/88 9:08:00 CALI: C22688 #5
SAMPLE: DIOXIN STD (18/5/88),1 UL
CONDS.: 30M DB-5, 80-->250@15-->300@5H20
RANGE: G 1,1350 LABEL: N 2,10.0 QUAN: A 10, 3.0 J 0 BASE: U 20, 1

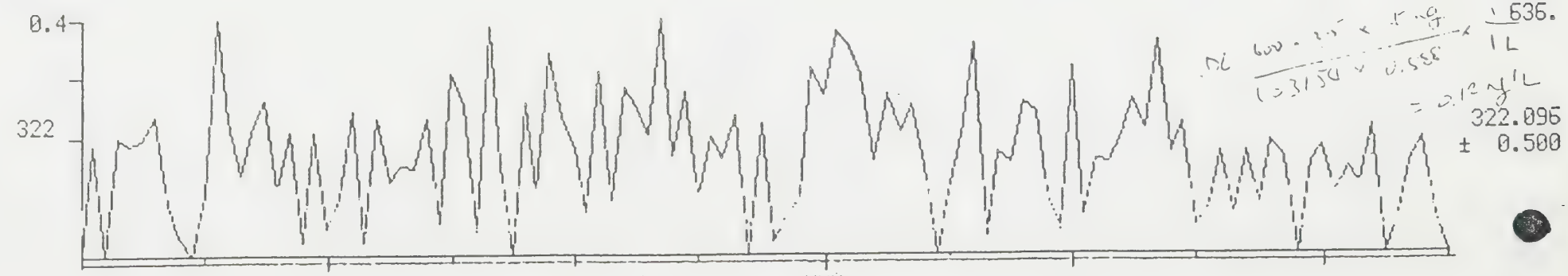


MID MASS CHROMATOGRAMS DATA: CR2869 #1 SCANS 740 TO 850
08/23/88 14:11:00 CALI: C22888 #5
SAMPLE: WATER #MH 32, 1/20 UL
CONDS.: 30M DB-5, 80-->250@15-->300@5H20
RANGE: G 1,1000 LABEL: N 2,10.0 QUAN: A 10, 3.0 J 0 BASE: U 20, 1



MID MASS CHROMATOGRAMS DATA: CR2870 #1 SCANS 740 TO 850
08/23/88 13:01:00 CALI: C22888 #5
SAMPLE: WATER # SEEP1, 1/20 UL
CONDS.: 30M DB-5, 80-->250@15-->300@5H20
RANGE: G 1,1000 LABEL: N 2,10.0 QUAN: A 10, 3.0 J 0 BASE: U 20, 1





300
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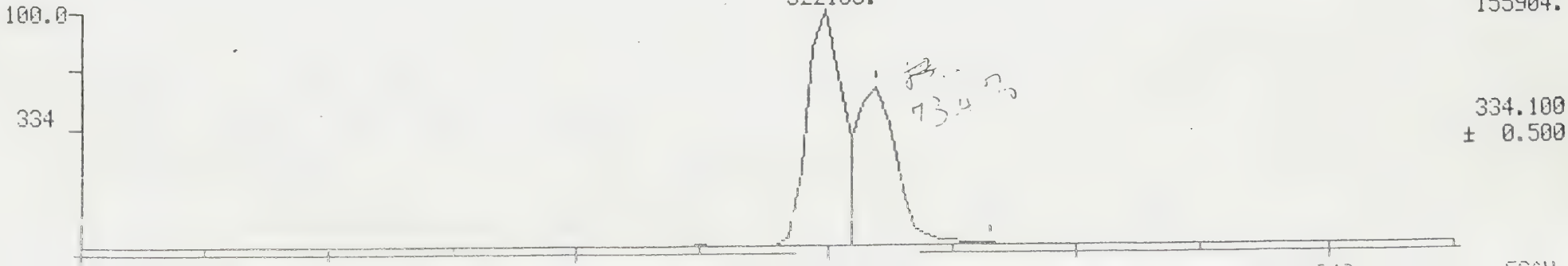
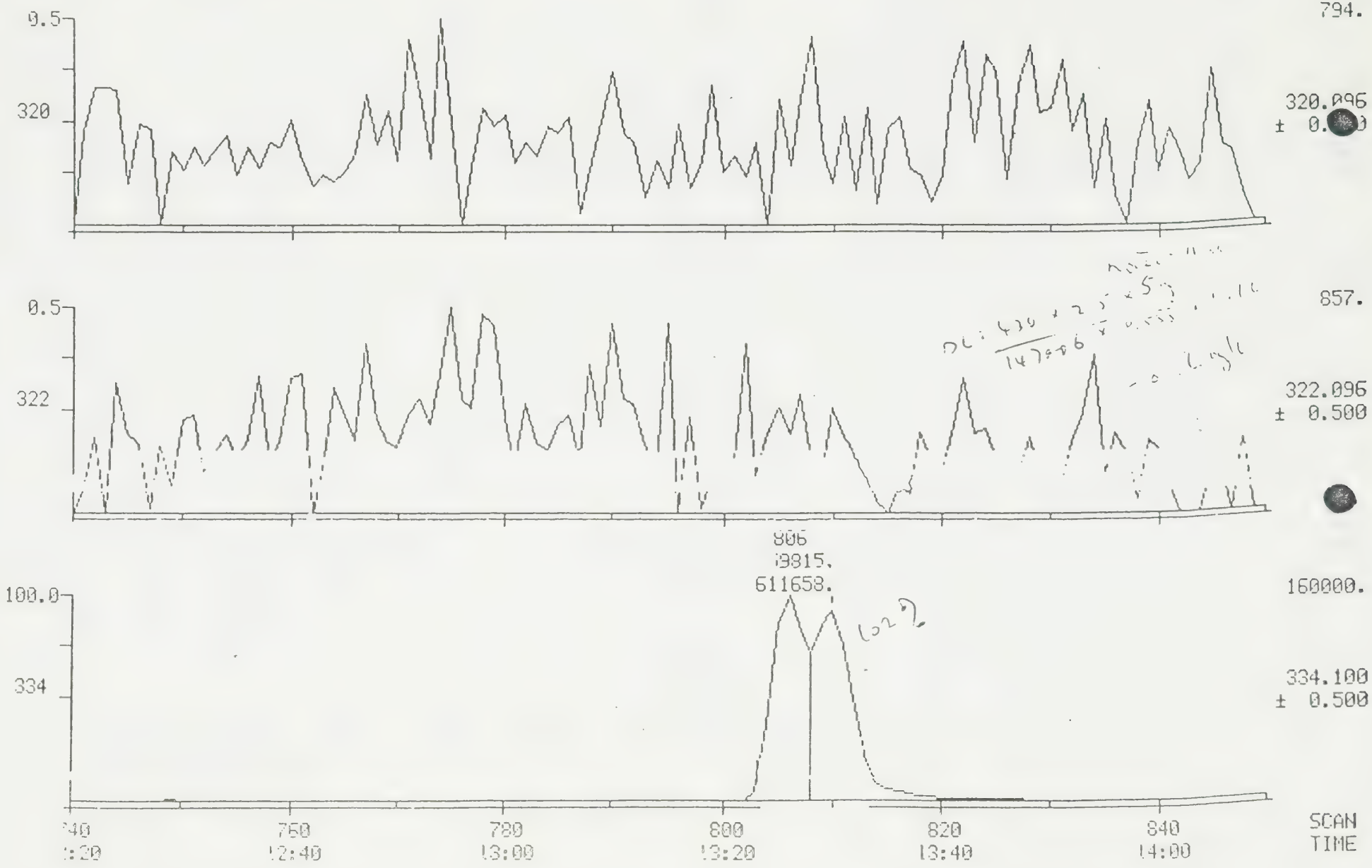


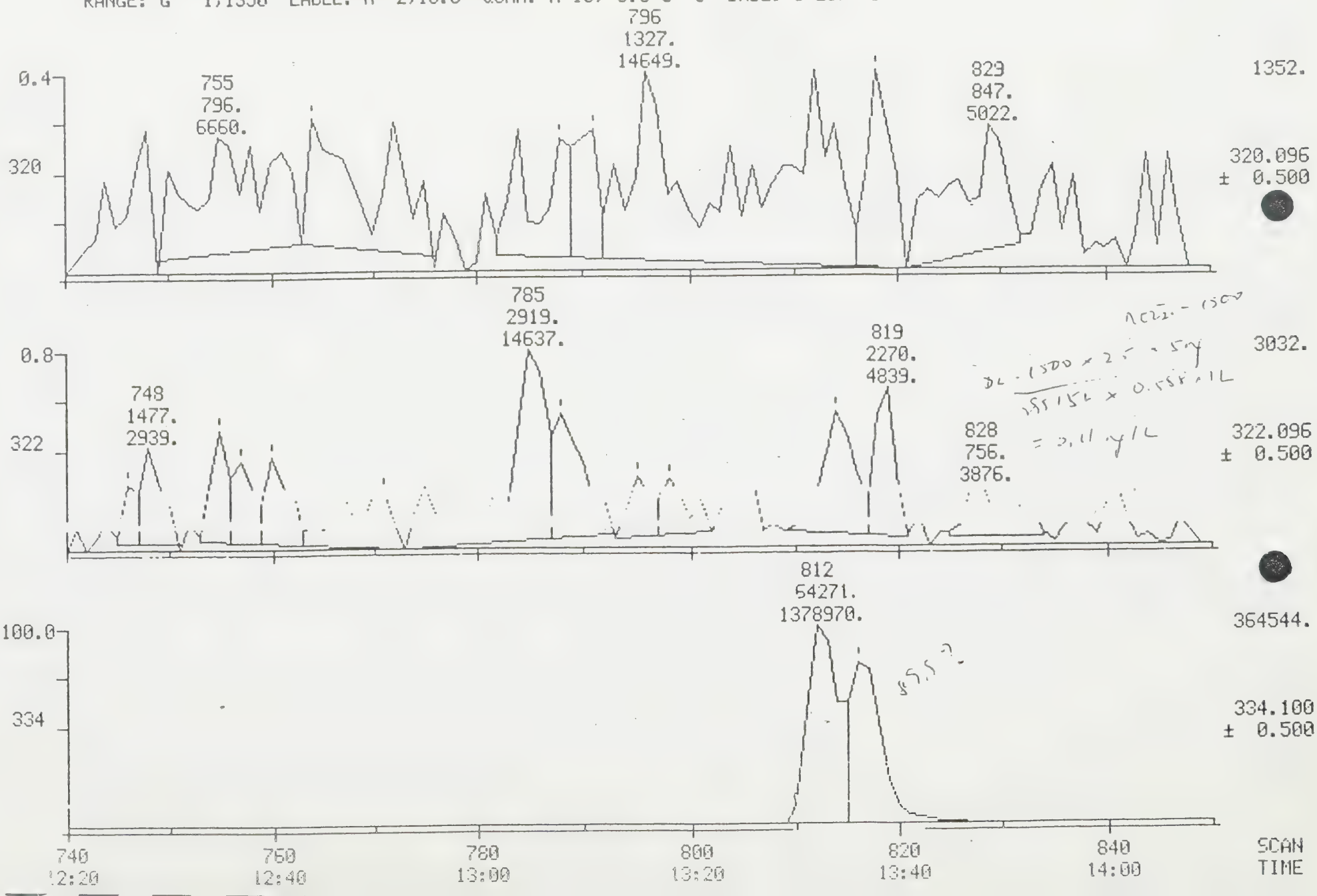
MID MASS CHROMATOGRAMS DATA: CR2871 #1 SCANS 740 TO 850
08/23/88 13:43:00 CALI: C22888 #5
SAMPLE: WATER # SEEP2, 1/20 UL
CONDS.: 30M DB-5, 80-->250@15-->300@5H20
RANGE: G 1,1000 LABEL: N 2,10.0 QUAN: A 10, 3.0 J 0 BASE: U 20, 1



MID MASS CHROMATOGRAMS
08/23/88 10:19:00
SAMPLE: BLANK WATER, 1/20 UL
CONDS.: 30M DB-5, 80-->250@15-->300@5H20
RANGE: G 1,1350 LABEL: N 2,10.0 QUAN: A 10, 3.0 J 0 BASE: U 20, 1

DATA: CRBLK #1
CALI: C22888 #5

SCANS 740 TO 850



NOVALAB LTÉE LTD

9420 CÔTE DE LIESSE, LACHINE, QUÉ. H8T 1A1

TÉL.: (514) 636-6218, 631-1838
TÉLEX: 05-822787 • (LYNJON)
FAX: (514) 631-9814

2184-30
MONITORING DATA

TO: Conestoga-Rovers & Associates Ltd
86 Rankin Street
Waterloo, Ontario
N2V 1C2

Attention: Ms. D. Hayes

DATE: Oct. 20, 1988

CLIENT ORDER #: 2184-30

REPORT #: NL-4122

RE: Analysis of Water Samples - Project 2184-30

Ms. Hayes,

Four (4) water samples were received on September 27, 1988. They were analysed by gc/ms according to the list of groundwater monitoring parameters (Table D-4) received together with the samples. Results and detection limits are shown in the attached Table.

Chromatograms will be kept on file. Results are not corrected for recovery.

Sincerely,

NOVALAB LIMITED

L.W. Tang, B.Sc.

Approved by J.D. Fenwick, Ph.D., P.Chem.

LWT/hl
encl.

CONCENTRATION OF MONOCYCLIC AROMATIC HYDROCARBONS IN WATER ✓

ug/L

COMPOUND	1-1	1-2	1-3	1-5	BLANK	MDL
BENZENE	1.1	-	-	-	-	2
CHLOROBENZENE	-	-	-	-	-	2
1,2-DICHLOROBENZENE	-	-	-	-	-	3
1,3-DICHLOROBENZENE	-	-	-	-	-	4
1,4-DICHLOROBENZENE	-	-	-	-	-	4
ETHYLBENZENE	-	-	-	-	-	2
A-METHYLSTYRENE	-	-	-	-	-	1
METHYLSTYRENE ISOMERS	-	-	-	-	-	1
MESITYLENE	-	-	-	-	-	1
TOLUENE	5	5.1	11	-	-	2
M+P-XYLENE	-	-	-	-	-	3
O-XYLENE	-	-	-	-	-	1
STYRENE	-	-	-	-	-	2
DICHLOROMETHANE	-	-	-	-	-	15
1,4-DIOXANE	-	-	-	-	-	75
TETRAHYDROFURAN	-	-	-	-	-	5
OTHER AROMATIC COMPOUNDS	-	1	-	-	-	1

MDL = METHOD DETECTION LIMITS

OTHER AROMATIC COMPOUNDS = Total concentration of tri- and tetramethylbenzenes using the response factor of mesitylene.

CONCENTRATION OF EXTRACTABLE POLLUTANTS IN WATER
ug/L

COMPOUND	1-1	1-2	1-3	1-5	BLANK	MDL
PHENOL	-	-	-	-	-	1
O-CRESOL	-	-	-	-	-	1
M+P-CRESOL	-	-	-	-	-	1
DIMETHYLPHYNOLS	-	-	-	-	-	6
BENZOTHIAZOLE	28	76	99	7.5	-	1
ANILEIN	-	-	-	-	-	1
BIS(2-ETHYLHEXYL)PHTHALATE	1.6	2.6	-	-	-	1
DI-N-BUTYLPHTHALATE	12	1.5	-	14	-	1
NAPHTHALATE	-	-	-	-	-	1
METHYL NAPHTHALENES	-	-	-	-	-	1

MDL = METHOD DETECTION LIMIT

RECOVERY OF SURROGATE STANDARDS
(%)

COMPOUND	1-1	1-2	1-3	1-5	BLANK
D5-PHENOL	16.5	21.5	±	49.5	47.6
TRIFLUOROMETHYL-M-CRESOL	16.9	18.4	±	81.5	75.1
D5-NITROBENZENE	78.1	78.7	62.9	80.5	73.5
D10-ANTHRACENE	82	86.3	±	82.7	86.7
D12-PERYLENE	98.1	100	100	91.4	100

± = Surrogate standard recoveries were not available to high concentrations of interference present in the sample.

NOVALAB LTÉE LTD

9420 CÔTE DE LIESSE, LACHINE, QUÉ. H8T 1A1

TÉL.: (514) 636-6218, 631-1838
TÉLEX: 05-822787 • (LYNJON)
FAX: (514) 631-9814

2184-30 ✓
MONITORING DATA

TO: Conestoga-Rovers & Associates Ltd
86 Rankin Street
Waterloo, Ontario
N2V 1C2

Attention: Ms. D. Hayes

DATE: Oct. 20, 1988

CLIENT ORDER #: 2184

REPORT #: NL-4121

RE: Analysis of Water Samples - Project 2184-30

Ms. Hayes,

Fourteen (14) water samples were received September 16, 1988. They were analysed by gc/ms according to the list of groundwater monitoring parameters (Table D-4) received together with the samples. One of the water samples was only analysed for the volatile pollutants listed in the Table. Results and detection limits are shown in the attached Tables.

Chromatograms will be kept on file. Results are not corrected for recovery.

Sincerely,

NOVALAB LIMITED

L.W. Tang, B.Sc.

Approved by J.D. Fenwick, Ph.D., P.Chem.

LWT/hl
encl.

CONCENTRATION OF EXTRACTABLE POLLUTANTS IN WATER
(ug/L)

COMPOUND	1-4	2-1	2-2	2-3	2-5	3-1	3-2	MDL
PHENOL	-	-	-	-	-	-	-	1
O-CRESOL	-	-	-	-	-	-	-	1
M+P-CRESOL	1.6	-	-	-	-	-	-	1
DIMETHYLPHENOLS	-	-	-	-	26	-	12	6
BENZOTHIAZOLE	62	240	33	16	-	32	10	1
BIS(2-ETHYLHEXYL)PHTHALATE	2.2	1.9	2	2.1	-	-	2.5	1
DI-N-BUTYL PHTHALATE	17	4.8	8.4	9.4	4	2.7	3.1	1
NAPHTHALENE	-	-	-	-	-	-	-	1
METHYL NAPHTHALENES	-	-	-	-	-	-	-	1
ANILINE	-	-	-	-	-	-	-	1

RECOVERY OF SURROGATE STANDARDS
(%)

COMPOUND	1-4	2-1	2-2	2-3	2-5	3-1	3-2
D5-PHENOL	18.7	29.8	33.2	16.8	22.4	47.3	22.5
TRIFLUOROMETHYL M-CRESOL	28.2	14.1	41.7	23.4	49.2	46.1	18.6
D5-NITROBENZENE	78	76.9	76.1	68.5	75.4	58.1	66.1
D10-ANTHRACENE	87.5	85.6	82.2	76	85.1	59.2	72.8
D12-PERYLENE	65.5	89.6	77.8	61.8	92.3	60.3	69.9

CONCENTRATION OF EXTRACTABLE POLLUTANTS IN WATER
(ug/L)

COMPOUND	3-3	3-4	3-5	4-1	4-3	4-4	BLANK	MDL
PHENOL	-	-	-	-	-	-	-	1
O-CRESOL	-	-	-	-	-	-	-	1
M+P-CRESOL	8.8	-	-	-	-	-	-	1
DIMETHYLPHENOLS	-	-	-	-	-	-	-	6
BENZOTHIAZOLE	1.4	3.5	9.1	11	2.4	8.2	-	1
BIS(2-ETHYLHEXYL)PHTHALATE	2.6	1.5	1.4	1.4	1.2	1.3	1.9	1
DI-N-BUTYL PHTHALATE	5.1	16	3.9	30	12	35	2.3	1
NAPHTHALENE	-	-	-	-	-	-	-	1
METHYL NAPHTHALENES	-	-	-	-	-	-	-	1
ANILINE	-	-	-	-	10	4.1	-	1

RECOVERY OF SURROGATE STANDARDS
(%)

COMPOUND	3-3	3-4	3-5	4-1	4-3	4-4	BLANK
D5-PHENOL	45.8	35.5	40.7	±	27.3	39.1	-
TRIFLUOROMETHYL M-CRESOL	85.2	67.6	94.7	±	61.7	74.7	-
D5-NITROBENZENE	70.3	56.3	47.8	68.3	83.3	61.9	46.8
D10-ANTHRACENE	73.5	70	73	55.9	63.9	58	98.1
D12-PERYLENE	77.8	67.3	76.3	48.7	54	55.9	100

± Surrogate revoveries were not available due to high concentrations of interference present in the sample.

CONCENTRATION OF VOLATILE POLLUTANTS IN WATER
ug/L

COMPOUND	1-4	2-1	2-2	2-3	2-4	2-5	3-1	3-2	MDL
BENZENE	-	1.5	-	-	-	-	4.8	2.3	2
CHLOROBENZENE	-	-	-	-	-	-	-	-	2
1,2-DICHLOROBENZENE	-	-	-	-	-	-	-	-	3
1,3-DICHLOROBENZENE	-	-	-	-	-	-	-	-	4
1,4-DICHLOROBENZENE	-	-	-	-	-	-	-	-	4
ETHYLBENZENE	-	-	-	-	-	-	-	-	2
A-METHYLSTYRENE	-	-	-	-	-	-	-	-	1
METHYLSTYRENE ISOMERS	-	-	-	-	-	-	-	-	1
MESITYLENE	-	-	-	-	-	-	-	-	1
TOLUENE	6	8.6	-	6.9	8.7	3.5	21	2.8	2
M+P-XYLENE	-	-	-	-	-	-	-	-	3
O-XYLENE	-	-	-	-	-	-	-	-	1
STYRENE	-	-	-	-	-	-	-	-	2
TETRAHYDROFURAN	-	320	13	9.4	6.6	30	93	76	5
1.4-DIOXANE	-	TR	87	TR	76	360	900	460	75
DICHLOROMETHANE	-	23	19	-	-	-	-	-	15
OTHER AROMATIC COMPOUNDS	-	-	-	-	-	-	-	-	1

MDL = METHOD DETECTION LIMITS

TR = TRACE

OTHER AROMATIC COMPOUNDS = Total concentration of tri- and tetramethylbenzenes using the response factor of mesitylene.

CONCENTRATION OF VOLATILE POLLUTANTS IN WATER
ug/L

COMPOUND	3-3	3-4	3-5	4-1	4-3	4-4	LAB BLANK	MDL
BENZENE	7.4	5.9	3.1	5.5	-	-	-	2
CHLOROBENZENE	-	-	-	-	-	-	-	2
1,2-DICHLOROBENZENE	-	-	-	-	-	-	-	3
1,3-DICHLOROBENZENE	-	-	-	-	-	-	-	4
1,4-DICHLOROBENZENE	-	-	-	-	-	-	-	4
ETHYLBENZENE	-	-	-	-	-	-	-	2
A-METHYLSTYRENE	-	-	-	-	-	-	-	1
METHYLSTYRENE ISOMERS	-	-	-	-	-	-	-	1
MESITYLENE	-	-	-	-	-	-	-	1
TOLUENE	3	8.1	3.9	11	7.9	22	-	2
M+P-XYLENE	TR	2	-	-	-	-	-	3
O-XYLENE	TR	1	-	-	-	-	-	1
STYRENE	-	-	-	-	-	-	-	2
TETRAHYDROFURAN	73	16	71	-	-	-	-	5
1.4-DIOXANE	740	130	940	-	-	-	-	75
DICHLOROMETHANE	-	-	31	-	-	-	-	15
OTHER AROMATIC COMPOUNDS	1	1.1	-	-	-	-	-	1

MDL = METHOD DETECTION LIMITS

TR = TRACE

OTHER AROMATIC COMPOUNDS = Total concentration of tri- and tetramethylbenzenes using the response factor of mesitylene.

THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

Department of Engineering
71 Main Street West, Hamilton, Ont. L8N 3T4 (416) 526-4170

2184-3

MONITORING DATA

Rec'd CRA OCT 4 1988

2184-OCT 30

Refer to File No E 309-22
Attention of V. Terluk
Your File No

September 30, 1988

Conestoga-Rover & Associates Limited
651 Colby Drive
Waterloo, Ontario
N2V 1C2

Attn: A.J.Crutcher

Environmental Site Monitoring Control
Upper Ottawa Street Landfill Site

Gentlemen,

Enclosed find analytical data on the surface waters of the Red Hill Creek, performed by the Ministry of the Environment in June 1987.

Please include the data in the forthcoming Environmental Monitoring Report for the Upper Ottawa Street Landfill Site.

V. Terluk

V.Terluk, Supervisor
Solid Waste Operations

GD/

Attach:

MINISTRY OF THE ENVIRONMENT
LABORATORY SERVICES BRANCH
DRINKING WATER ORGANICS SECTION
MASS SPECTROMETRY ANALYTICAL REPORT

To: Stan Irwin, Hamilton District Office
West Central Region

Re: GC/MS Analysis of samples from the Upper Ottawa St Landfill site

Submission No: WC 04488

MS Reference No.	Other Lab No.	Sample Description
MY19-0224/5 (2)		L/F leachate
		2-1L glass cc. via taxi (S. Irwin 870825)

For additional information contact: Dr. V.Y. Taguchi
(416) ~~248-3755~~ 235-5904
(416) ~~248-7484~~

c.c. H. Tosine
L.I.S.
Dr. O. Meresz
Ian Carter, OTC

Extractable organics were determined in the following manner:

Internal standards were added to the samples to permit quantification of the components present. The samples were extracted under basic and acid conditions and the extracts concentrated prior to GC/MS analysis of the extractable fractions. The compounds were separated using capillary GC and were identified using mass spectrometry. The components isolated have only approximate concentrations marked. This approximation is based on three major assumptions which are:

1. The extraction efficiency of the compound is identical to that of the internal standard added to each sample.

2. The GC behaviour of the compound is identical to that of the internal standard.

3. The MS response of the compound is identical to that of the internal standard.

These assumptions may not hold and any deviation will affect the estimate of concentration.

The results for the analysis are indicated in the attached table(s).

Volatile organics were determined in the following manner:

Internal standards were added to the samples to permit quantification of the components present. The samples were analyzed by a purge and trap technique followed by capillary GC/MS to separate, identify and quantify the organics. The compounds found and their concentrations are indicated in the attached table(s). Many of the components isolated have only approximate concentrations marked. This approximation is based on three major assumptions which are:

1. The purging efficiency of the compound is identical to that of the internal standard added to each sample.

2. The GC behaviour of the compound is identical to that of the internal standard.

3. The MS response of the compound is identical to that of the internal standard.

These assumptions may not hold and any deviation will affect the estimate of concentration.

The analytical data are presented in the attached tables.

Reference:

LIS Submission No: WC 04488

Date of Analysis: 87 06 23

V.Y. Taguchi, Ph.D.

c.c. H. Tosine
L.I.S.
Dr. O. Maresz
Ian Carter, OTC

ORGANIC.

04488

Date Sampled: 87 05 04 surface water (Rockhill Ave.

Date Analyzed: 87 06 03 Samples MY19-0224/5

Upper Ottawa Street L/F

Compound	MY19	downstr. SW 2 -0224	upstr. SW 4 -0225		
Methylene Chloride		0.5	0.7		
1,1-Dichloroethylene		ND	ND		
I.S Bromochloromethane		✓	✓		
1,1-Dichloroethane		ND	ND		
Chloroform		tr	ND		
1,2-Dichloroethane		ND	ND		
1,1,1-Trichloroethane		ND	ND		
Carbontetrachloride		ND	ND		
Dichlorobromomethane		ND	ND		
1,2-Dichloropropane		ND	ND		
Benzene		tr	tr		
Trichloroethylene		ND	0.2		
1,1,2-Trichloroethane		ND	ND		
Chlorodibromomethane		ND	ND		
1,2-Dibromoethane		ND	ND		
Bromoform		ND	ND		
I.S. 1,3-Dichlorobutane		✓	✓		
Tetrachloroethylene		ND	ND		
Toluene		ND	ND		
1,1,2,2-Tetrachloroethane		ND	ND		
Chlorobenzene		ND	ND		
Ethylbenzene		tr	ND		
m-Xylene		ND	ND		
o- or p-Xylene		ND	ND		
1,2-Dichlorobenzene		ND	ND		

NOTES
ND - not detected - less 0.05 ug/litre
ND† - not detected - less than 5 ug/litre
tr - trace - less than 0.1 ug/litre
* - approximate - response of standard not determined

...ronment ORGANIC

NC04488

Date Sampled: 87 05 04

Date Analyzed: 87 06 03

Surface waters (Red Hill Creek)

Samples MY19-0224 /5

Upper O'Hara Street ~/F

Compound	MY19	DH 1 downstr. SW 2 - 0224	DH 2 upstr. SW 4 - 0225		
Chlorinated :-					
- 1,2- dichloroethylene			0.3		
- chlorobutene			0.1		
- dichlorobenzene			0.1		
Aromatic Hydrocarbons :-					
- C2 alkyl benzene		1.5			
- C3 "		2.9^3			
- C4 "		3.3^{11}			
- C5 "		1.2^7			
- tetralin		0.1			
- $C_{10}H_{12}$ aromatic Hc		0.6^2			
- $C_{11}H_{14}$ "		1.2			
- Methyl Styrene		0.8^7			
Miscellaneous :-					
- acetone		0.1	0.1		
- dimethyl sulfide		0.1			
- propanol			0.1		
- 1,4-diethylene dioxide			0.1		
- hydrocarbons		0.1			

NOTES

~~ND - not detected - less than 0.05 ug/litre~~

~~ND† - not detected - less than 5 ug/litre~~

~~tr - trace - less than 0.1 ug/litre~~

* - approximate - response of standard not determined

superscript # - number of compounds

...ironment

04488

Date Sampled: 87 05 04

Date Analyzed: 87 06 11

Surface water (Red Hill Creek)

Samples MY19 - 0224 / 5

Upper Ottawa Street

Compound	MY19	DH1 ~~downstr.~~ SW 2 - 0224	DH2 ~~upstr.~~ SW 4 - 0225		
Nitrogen Compounds:-					
- 3-(2-hydroxypropyl)-5-methyl -2-oxazolidone			1.2		
- N,N-diethyl-3-methyl benzamide			1.2		
- benzothiazolone			1.6		
Carboxylic Acids :-					
- C8 carboxylic acid			3.2		
- C9 "			4.0		
- C4 alkyl benzoic acid			0.9		
Miscellaneous :-					
- caffeine		0.6			
Unidentified			45^3		

NOTES

~~ND - not detected - less than 0.05 ug/litre~~
~~ND1 - not detected - less than 5 ug/litre~~
~~tr - trace - less than 0.1 ug/litre~~
* - approximate - response of standard not determined
superscript # - number of compounds

1286 (10/84)

FILE COPY

NOVALAB LTÉE LTD

9420 CÔTE DE LIESSE, LACHINE, QUÉ. H8T 1A1

TÉL.: (514) 636-6218, 631-1838
TÉLEX: 05-822787 • (LYNJON)
FAX: (514) 631-9814

TO: Conestoga-Rovers & Associates Ltd
86 Rankin Street
Waterloo, Ontario
N2V 1C2

Attention: Ms. D. Hayes

DATE: Nov. 9, 1988

CLIENT ORDER #: 2184-30

REPORT #: NL-4194

RE: Analysis of Water Samples - Project 2184-30

Ms. Hayes,

Seven (7) water samples were received September 20, 1988. Two (2) water samples were analysed for VOC and BNAE according to Table D-2, two (2) water samples were analysed for VOC and BNAE according to Table D-4, and four (4) water samples were analysed for VOC, BNAE (including TCDD), organochlorinated pesticides and PCB according to Table D-1. These Tables of required compounds were received with the water samples. Results and detection limits are shown in the attached Tables.

Chromatograms will be kept on file. Results are not corrected for recovery.

Sincerely,

NOVALAB LIMITED

L.W. Tang, B.Sc.

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74-024
QUEBEC

LWT/hl
encl.

NL-4194

Concentration of PCB in Water Samples (µg/L)

Sample	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Seep 1	ND	TR	0.03	ND
Seep 2	ND	TR	0.02	ND
Leach MH	ND	1.2	0.08	ND
Detection Limits	0.05	0.05	0.02	0.02

TR = Trace

Concentration of 2,3,7,8-TCDD in Water Samples (ng/L)

Sample	TCDD	Recovery of 2,3,7,8-TCDD 12C13 Surrogate
Seep 1	< 0.10	53.6
Seep 2	< 0.12	59.1
Leach MH	< 0.16	54.0

CONCENTRATION OF OC PESTICIDES IN WATER

ug/L

COMPOUND	SEEP 1	SEEP 2	LEACH MH	MDL
HCB	-	-	-	0.001
HEPTACHLOR	-	-	-	0.002
ALDRIN	-	-	-	0.003
p,p'-DDE	-	-	-	0.007
MIREX	-	-	-	0.02
A-BHC	-	-	0.003	0.001
B-BHC	-	-	-	0.002
LINDANE	-	-	-	0.02
D-BHC	-	-	-	0.002
HEPTACHLOR EPOXIDE	-	-	-	0.004
CIS-CHLORDANE	-	-	-	0.005
TRANS-CHLORDANE	-	-	-	0.005
o,p'-DDD	-	-	-	0.003
o,p'-DDT	-	-	-	0.01
p,p'-DDD	-	-	-	0.01
p,p'DDT	-	-	-	0.02
METHOXYCHLOR	-	-	-	0.08
A-ENDOSULFAN	-	-	-	0.006
DIELDRIN	-	-	-	0.009
ENDRIN	-	-	-	0.02
B-ENDOSULFAN	-	-	-	0.01
ENDRIN ALDEHYDE	-	-	-	0.01
ENDOSULFAN SULFATE	-	-	-	0.06
TOXAPHENE	-	-	-	1

CONCENTRATION OF EXTRACTABLE POLLUTANTS IN WATER
ug/L

COMPOUND	SP-1	SP-2	MP-4-2	MP-4-5	BLANK	MDL
PHENOL	-	-	-	-	-	1
O-CRESOL	-	-	-	-	-	1
M+P-CRESOL	-	-	-	-	-	1
DIMETHYLPHYNOLS	-	-	-	-	-	6
BENZOTHIAZOLE	-	-	-	-	-	1
ANILINE	-	-	-	-	-	1
BIS(2-ETHYLHEXYL)PHTHALATE	-	5.7	-	-	-	1
DI-N-BUTYLPHTHALATE	-	2.8	-	-	-	1
NAPHTHALATE	-	-	-	-	-	1
METHYL NAPHTHALENES	-	-	-	-	-	1

MDL = METHOD DETECTION LIMIT

RECOVERY OF SURROGATE STANDARDS
(%)

COMPOUND	SP-1	SP-2	MP-4-2	MP-4-5	BLANK
D5-PHENOL	46.4	44.8	51.9	42	45.6
TRIFLUOROMETHYL-M-CRESOL	79.1	71.1	66.3	71.8	65.2
D5-NITROBENZENE	72.8	40.1	30.9	74.5	82.3
D10-ANTHRACENE	78.5	57	27.6	84.2	85.3
D12-PERYLENE	51.3	39.1	21.8	63	81

CONCENTRATION OF VOLATILE PRIORITY POLLUTANTS IN WATER
ug/L

COMPOUND	MP4-2	MP4-5	SP-1	SP-2	BLANK	MDL
BENZENE	4.3	-	-	-	-	2
CHLOROBENZENE	-	-	-	-	-	2
1,2-DICHLOROBENZENE	-	-	-	-	-	3
1,3-DICHLOROBENZENE	-	-	-	-	-	4
1,4-DICHLOROBENZENE	-	-	-	-	-	4
ETHYLBENZENE	-	-	-	-	-	2
A-METHYLSTYRENE	-	-	-	-	-	1
METHYLSTYRENE ISOMERS	-	-	-	-	-	1
MESITYLENE	-	-	-	-	-	1
TOLUENE	-	-	-	-	-	2
M+P-XYLENE	-	-	-	-	-	3
O-XYLENE	-	-	-	-	-	1
STYRENE	-	-	-	-	-	2
DICHLOROMETHANE	-	-	-	-	-	15
TETRAHYDROFURAN	-	7.5	-	-	-	5
1,4-DIOXANE	-	-	-	-	-	75
OTHER AROMATIC COMPOUNDS	-	-	-	-	-	1

MDL = METHOD DETECTION LIMITS

OTHER AROMATIC COMPOUNDS = Total concentration of tri- and tetramethylbenzenes using the response factor of mesitylene.

CONCENTRATION OF VOLATILE PRIORITY POLLUTANTS IN WATER

ug/L

COMPOUND	SEEP 1	SEEP 2	LEACH MH	BLANK	MDL
BENZENE	2.6	6.5	3	-	1
BROMODICHLOROMETHANE	-	-	-	-	1
BROMOFORM	-	-	-	-	2
BROMOMETHANE	-	-	-	-	16
CARBON TETRACHLORIDE	-	-	-	-	2
CHLOROBENZENE	-	-	-	-	1
CHLOROETHANE	-	-	-	-	10
2-CHLOROETHYL VINYL ETHER	-	-	-	-	10
CHLOROFORM	-	-	-	-	1
CHLOROMETHANE	-	-	-	-	50
DIBROMOCHLOROMETHANE	-	-	-	-	1
1,2-DICHLOROBENZENE	1.6	-	TR	-	1
1,3-DICHLOROBENZENE	5.7	-	-	-	1
1,4-DICHLOROBENZENE	9.1	1.8	5.2	-	1
1,1-DICHLOROETHYLENE	-	-	-	-	1
1,1-DICHLOROETHANE	-	-	-	-	1
1,2-DICHLOROETHANE	-	-	-	-	2
TRANS-1,2-DICHLOROETHYLENE	-	-	-	-	1
DICHLOROMETHANE	-	-	-	-	10
1,2-DICHLOROPROPANE	-	-	-	-	1
CIS-1,3-DICHLOROPROPENE	-	-	-	-	1
TRANS-1,3-DICHLOROPROPENE	-	-	-	-	1
ETHYLBENZENE	-	-	-	-	1
A-METHYLSTYRENE	-	-	1.5	-	1
METHYLSTYRENE ISOMERS	-	-	19	-	1
MESITYLENE	-	-	6	-	1
1,1,2,2-TETRACHLOROETHANE	-	-	-	-	2
TETRACHLOROETHYLENE	-	-	-	-	1
TOLUENE	-	-	-	-	2
1,1,1-TRICHLOROETHANE	-	-	-	-	2
1,1,2-TRICHLOROETHANE	-	-	-	-	1
TRICHLOROETHYLENE	-	-	-	-	1
TRICHLOROFLUOROMETHANE	-	-	-	-	2
M+P-XYLENE	5.9	17	2.4	-	2
O-XYLENE	16	TR	22	-	1
VINYL CHLORIDE	-	-	-	-	12
OTHER AROMATIC COMPOUNDS	560	55	48	-	1

MDL = METHOD DETECTION LIMITS

TR = TRACE

OTHER AROMATIC COMPOUNDS = Total concentration of tri-and tetramethylbenzenes using the response factor of mesitylene.

CONCENTRATION OF BASE/NEUTRAL PRIORITY POLLUTANTS IN WATER

ug/L

COMPOUND	SEEP 1	SEEP 2	LEACH MH	BLANK	MDL
ACENAPHTHENE	4	1.3	2.7	-	1
ACENAPHTHYLENE	-	-	1.6	-	1
ANTHRACENE	TR	-	-	-	1
BENZIDINE	-	-	-	-	20
BENZ(A)ANTHRACENE	-	-	-	-	1
BENZO(B)FLUORANTHENE]					
BENZO(K)FLUORANTHENE]	-	-	-	-	2
BENZO(A)PYRENE	-	-	-	-	3
BENZO(GHI)PERYLENE	-	-	-	-	5
BENZYL BUTYL PHTHALATE	-	-	-	-	1
BIS(2-CHLOROETHYL)ETHER	-	-	-	-	1
BIS(2-CHLOROETHOXY)METHANE	-	-	-	-	1
BIS(2-ETHYLHEXYL)PHTHALATE	1.6	1.1	2.2	-	1
BIS(2-CHLOROISOPROPYL)ETHER	-	-	-	-	1
4-BROMOPHENYL PHENYL ETHER	-	-	-	-	1
2-CHLORONAPHTHALENE	-	-	-	-	1
4-CHLOROPHENYL PHENYL ETHER	-	-	-	-	1
CHRYSENE	-	-	-	-	2
DIBENZ(A,H)ANTHRACENE	-	-	-	-	5
DI-N-BUTYL PHTHALATE	-	-	-	-	1
1,3-DICHLOROBENZENE	2.3	-	-	-	1
1,4-DICHLOROBENZENE	4.9	1.9	3.9	-	1
1,2-DICHLOROBENZENE	-	-	-	-	1
3,3'-DICHLOROBENZIDINE	-	-	-	-	1
DIETHYL PHTHALATE	-	-	-	-	1
DIMETHYL PHTHALATE	-	-	-	-	1
2,4-DINITROTOLUENE	-	-	-	-	3
2,6-DINITROTOLUENE	-	-	-	-	3
1,2-DIPHENYLHYDRAZINE	-	-	-	-	1
DI-N-OCTYL PHTHALATE	-	-	-	-	1
FLUORANTHENE	-	-	-	-	1
FLUORENE	3.4	1.7	3.3	-	1
HEXACHLOROBENZZNE	-	-	-	-	1
HEXACHLOROBUTADIENE	-	-	-	-	3
HEXACHLOROCYCLOPENTADIENE	-	-	-	-	5
HEXACHLOROETHANE	-	-	-	-	3
INDENO(1,2,3-CD)PYRENE	-	-	-	-	5
ISOPHORONE	-	-	-	-	1
NAPHTHALENE	-	-	-	-	1
NITROBENZENE	-	-	-	-	1
N-NITROSO-DI-N-PROPYLAMINE	-	-	-	-	1
N-NITROSODIPHENYLAMINE	4.1	1.3	4.6	-	1
PHENANTHRENE	1.9	-	-	-	1
PYRENE	-	-	-	-	1
1,2,4-TRICHLOROBENZENE	-	-	-	-	1

MDL = METHOD DETECTION LIMIT

TR = TRACE

Total concentration of benzo(b)- and benzo(k)fluoranthene is shown in the row for benzo(k)fluoranthene.

CONCENTRATION OF ACIDIC PRIORITY POLLUTANTS IN WATER
ug/L

COMPOUND	SEEP 1	SEEP 2	LEACH MH	BLANK	MDL
PHENOL	-	-	3.9	-	2
2-CHLOROPHENOL	-	-	-	-	2
2,4-DIMETHYLPHENOL	6	7.7	18	-	12
4-CHLORO-3-METHYLPHENOL	-	-	-	-	2
2,4-DICHLOROPHENOL	-	-	-	-	2
2,4,6-TRICHLOROPHENOL	-	-	-	-	2
2-NITROPHENOL	-	-	-	-	4
2,4-DINITROPHENOL	-	-	-	-	12
2-METHYL-4,6-DINITROPHENOL	-	-	-	-	10
4-NITROPHENOL	-	-	-	-	10
PENTACHLOROPHENOL	-	-	-	-	6
OTHER DIMETHYLPHENOLS	14	-	66	-	6

MDL = METHOD DETECTION LIMIT

RECOVERY OF SURROGATE STANDARDS
(%)

COMPOUND	SEEP 1	SEEP 2	LEACH MH	BLANK
D5-PHENOL	38.8	40.2	49.3	45.6
TRIFLUOROMETHYL-M-CRESOL	27.9	60	77.9	65.2
D5-NITROBENZENE	69.8	63.5	58.7	82.3
D10-ANTHRACENE	77.6	78.9	73.4	85.3
D12-PERYLENE	56.3	63.5	58.3	81

APPENDIX F

HISTORIC GROUNDWATER AND LEACHATE QUALITY DATA

(as presented in RFP)

Table 7: GC-MS Analyses of Leachate
parts per billion

	Site 3[a]	Site 9[a]	Site 11[b]	Site 12[a]	Site 15[c]	Site 18[a]	Site 32[d]	RQL[e]	Drinking Water Criteria[f,g]
benzene	1.9	1.1	0.6	2.8	7.2	9.1	3.6	1.0	1.0[g]
toluene	BRQL	BRQL	1.3	BRQL	229	12.1	30.4	1.0	50.0[g]
xylenes	14.7	BRQL	164	63.7	332	50.0	142	1.0	50.0[g]
ethylbenzene	1.1	ND	24.1	ND	74.0	14.2	9.2	1.0	50.0[g]
C_3-benzenes	3.0	BRQL	1,396	BRQL	275	18.2	15.8	1.0	50.0[g]
C_4-benzenes	2.1	2.6	D	19.3	212	5.0	5.2	1.0	
dichloromethane	19.7	BRQL	4.8	BRQL	ND	BRQL	21,800	5.0	50.0[g]
dichlorobenzenes	BRQL	BRQL	21.3	24.4	ND	BRQL	11.8	1.0	20.0[g]
di-n-butyl phthalate	3.9	5.2	85.6	10.3	ND	23.4	2.5	0.4	50.0[g]
bis(2-ethylhexyl)phthlate	240	201	ND	147	350	147	360	0.9	4.0[g]
phenol	ND	ND	12.3	ND	92	105	98.1	3.0	2.0[f]
cresols	ND	ND	ND	ND	134	9.1	25.7	3.0	2.0[f]
xylenols	ND	BRQL	40.8	BRQL	576	36.4	10.5	2.0	2.0[f]
aniline	ND	ND	72.8	ND	ND	ND	15.0		1.0[g]
tetrahydrofuran	1,043	18.5	D	343	23.9	330	3,700	1.0	50.0[g]
1,4-dioxane	2,610	103	D	1,951	26.6	4,926	18,663	80	
benzothiazole	ND	ND	24.5	BRQL	D	ND	ND	0.8	

Notes: Location of sampling sites shown in Figure 6.

a Analyzed by Mann Testing Laboratories.
b Analyzed by Stanford University.
c Analyzed by the Ontario Ministry of the Environment.
d Samples from leachate collection manhole collected in July 1983, March, October and December 1984, and analyzed by Mann Testing Laboratories. Highest values reported. (Target compound analysis)
e RQL means Reliable Quantification Limit of the analytical method.
f Ontario Ministry of the Environment Drinking Water Objectives (where available).
g New York State Proposed Drinking Water Toxic Standards, January 1985 (where available).

D means the compound is detected but the amount not determined.
BRQL means detected but Below Reliable Quantification Limit
ND means the compound was searched for; if present, the amount is below the detection limit.

Table 11: GC-MS Monitoring of Surface Waters[a]
parts per billion

	Site 32 (Leachate Collection Manhole)				Site 2 (Upstream)				Site 22 (Downstream)				RQL[f]	Drinking Water Criteria[g,h]
	1[b]	2[c]	3[d]	4[e]	1	2	3	4	1	2	3	4		
benzene	3.6	ND	BRQL	BRQL	BRQL	ND	ND	ND	BRQL	ND	ND	ND	1.0	1.0[h]
toluene	30.4	BRQL	2.6	3.5	BRQL	ND	ND	ND	BRQL	ND	ND	ND	1.0	50.0[h]
xylenes	142	ND	13.5	49.3	ND	ND	BRQL	ND	BRQL	ND	ND	ND	1.0	50.0[h]
ethylbenzene	9.2	ND	ND	ND	ND	ND	ND	ND	BRQL	ND	ND	ND	1.0	50.0[h]
trimethylbenzenes	15.8	ND	1.0	5.4	ND	ND	ND	ND	ND	ND	ND	ND	1.0	50.0[h]
tetramethylbenzenes	5.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0	
dichloromethane	222	18.8	21,800	11,700	BRQL	31.5	BRQL	ND	15.2	31.8	ND	BRQL	5.0	50.0[h]
dichlorobenzenes	11.8	7.7	3.9	3.3	BRQL	BRQL	BRQL	ND	BRQL	BRQL	BRQL	ND	1.0	20.0[h]
di-n-butyl phthalate	NR	BRQL	ND	2.5	NR	ND	BRQL	1.2	NR	ND	ND	1.2	0.4	
bis(2-ethylhexyl) phthalate	13.1	360	17.6	51.6	24.3	24.8	6.0	13.2	21.2	92.0	7.2	7.1	0.9	4.0[h]
phenol	98.1	BRQL	BRQL	BRQL	BRQL	ND	ND	ND	70.2	ND	ND	1.5	1.5	2.0[g]
cresols	25.7	ND	ND	ND	ND	ND	ND	ND	11.1	ND	ND	ND	3.0	2.0[g]
xylenols	10.5	7.4	BRQL	BRQL	ND	BRQL	ND	ND	5.6	BRQL	BRQL	ND	2.0	2.0[g]
aniline	13.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		1.0[h]
tetrahydrofuran	1,213	1,549	2,457	3,700	BRQL	ND	ND	ND	1.4	ND	4.5	2.7	1.0	50.0[h]
1,4-dioxane	18,663	949	6,745	16,700	ND	ND	ND	ND	ND	ND	68.4	ND	80.0	

Notes: Location of sampling sites shown in Figure 6.

[a] All analyses by Mann Testing Laboratories.(Target compound analysis)
[b] Sampled in July, 1983.
[c] Sampled in March, 1984.
[d] Sampled in October, 1984.
[e] Sampled in December, 1984.
[f] RQL means Reliable Quantification Limit of the analytical method.
[g] Ontario Ministry of the Environment Drinking Water Objectives (where available).
[h] New York State Proposed Drinking Water Toxics Standards, January 1985 (where available).

BRQL means Detected but Below Reliable Quantification Limit
ND means the compound was searched for; if present, the amount is below the detection limit.
NR means the presence or absence of the compound was not reported by the laboratory.

Table 17: Results Of The GC-MS Analyses Of Organics In Groundwaters
parts per billion

	Near to the Landfill							Distant from the Landfill								
	Site 15[a]	Site 10[a]	Site 13[b]	Site 20[a]	Site 21[b]	Site 30[c]	Site 33[b]	Site 4[a]	Site 25		Site 23[a]			Site 28[a]	RQL[d]	Drinking Water Criteria[e,f]
Sampling Depth	(Leachate)	4.6m	48.5m	3.7m	12.2m	21m	15.6m	10m	7.2m[b]	16.2m[c]	4.4m	12.6m	59.m	24.1m		
benzene	6.9	3.5	4.9	0.9	9.0	1.3	ND	BRQL	ND	ND	BRQL			BRQL	1.0	1.0[f]
toluene	229	2.0	43.8	0.9	8.7	2.2	85.0	BRQL	1.8	4.8	BRQL			BRQL	1.0	50.0[f]
xylenes	332	9.0	3.4	BRQL	2.0	4.1	2.8	BRQL	1.4	0.7	BRQL			1.3	1.0	50.0[f]
ethylbenzene	69.4	3.1	BRQL	BRQL	BRQL	BRQL	BRQL	BRQL	ND	0.2	BRQL			BRQL		50.0[f]
C_3-benzenes	275	3.8	ND	BRQL	ND	ND	ND	BRQL	54.0	ND	BRQL			1.2	1.0	50.0[f]
C_4-benzenes	212	ND	ND	ND	ND	ND	ND	ND	14.0	ND	ND			ND	1.0	
naphthalene	D	0.5	D	0.8	D	D	ND	BRQL	ND		BRQL	ND	D	0.5	0.4	10.0[f]
methylnaphthalenes	ND	0.5	ND	0.5	ND	ND	ND	BRQL	ND		BRQL			0.6		
dichloromethane	ND	6.1	BRQL	ND	ND	5.6	39.6	ND	ND	ND	ND			D	5.0	50.0[f]
dichlorobenzenes	ND	BRQL	ND	BRQL	ND	ND	ND	BRQL	9.0	ND	BRQL			BRQL	1.0	20.0[f]
di-n-or di-isobutyl phthalate	73	2.9	40.0	17.3	6.0	D	D	4.8	5.0	(D)[g]		8.7	2.7		0.4	
bis(2-ethylhexyl) phthalate	350	ND	100	ND	ND	ND	ND	ND	20.0	(D)[g]		ND	ND		0.9	4.0[f]
phenol	92	10.4	ND	1.5	ND	ND	ND	ND	3.0			BRQL	14.5		1.5	2.0[e]
cresols	134	ND	ND	ND	ND	ND	ND	ND	ND			BRQL	ND		3.0	2.0[e]
xylenols	576	16.2	ND	ND	ND	ND	ND	ND	7.0			ND	ND		2.0	2.0[e]
aniline	ND	ND	ND	BRQL	ND	ND	ND	ND	D			5.6	ND			1.0[f]
tetrahydrofuran	23.9	D	166	ND	2.1	D	271	ND	6.0	ND	ND	ND	ND	(D)[g]	1.0	50.0[f]
1,4-dioxane	26.6	ND	BRQL	ND	ND	ND	ND	ND	4.0	ND	ND			ND	80.0	
benzothiazole	D	4.9	10.0	94.3	238	D	11.0	4.9	D	(D)[g]		BRQL	1.4		0.8	

Notes: Location of sampling sites shown in Figure 6.

[a] Analyzed by Stanford University.
[b] Analyzed by the Ontario Ministry of the Environment.
[c] Analyzed by Mann Testing Laboratories.
[d] RQL means Reliable Quantification Limit of the analytical method.
[e] Ontario Ministry of the Environment Drinking Water Objectives (where available).
[f] New York State Proposed Drinking Water Toxics Standards, January 1985 (where available).
[g] Found at another depth in the same borehole.

D means the compound was detected but the amount not determined.
BRQL means Detected but Below Reliable Quantification Limit.
ND means the compound was searched for; if present, the amount is below the detection limit.
Where data are not given in this table, the presence or absence of the compound was not reported by the laboratory.